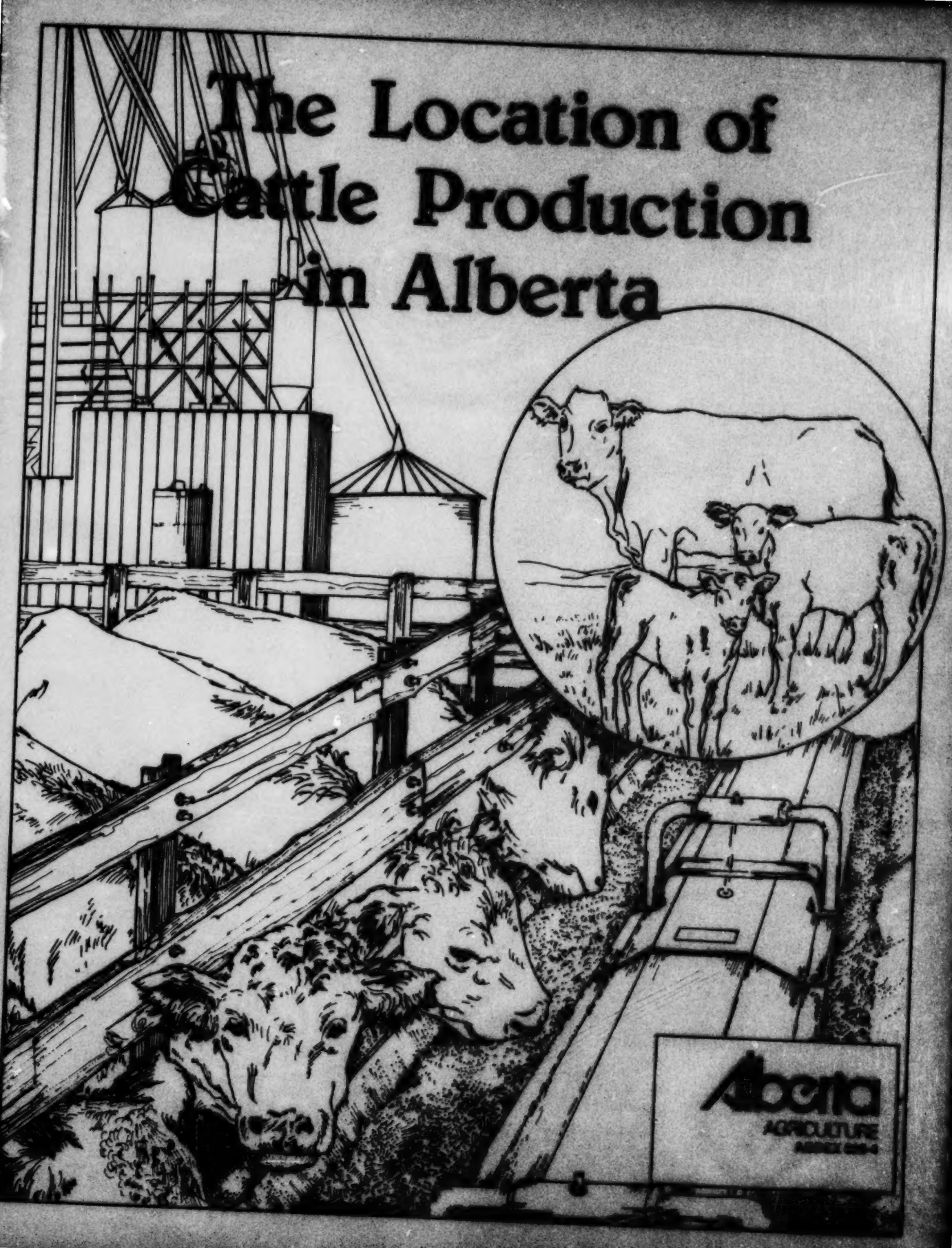
The Location of Cattle Production in Alberta



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THE LOCATION OF CATTLE PRODUCTION IN ALBERTA

by

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Production Economics Branch
Economic Services Division
Alberta Agriculture

November 1990

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Due to time constraints, a study of this nature could not be completed without the involvement of a number of individuals within and outside Alberta Agriculture. The Working Group consisted of a number of production economics branch staff, including Kathleen MacDonald-Date, Rudy Susko, Darren Chase, Elwin Smith and Carlyle Ross, the project leader. Kathleen MacDonald-Date, Dale Kaliel, Darren Chase and Carlyle Ross were responsible for conducting the field interviews and assembling the data-base. Dale Kaliel wrote the summary of the field interviews. Rudy Susko was responsible for the econometrics, while Elwin Smith prepared the section on theoretical framework. Carlyle Ross was responsible for writing the introduction, the review of cattle production and putting the entire report together.

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Carlyle Ross, Head
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I. INTRODUCTION

1.1 Background

Cattle production is an integral part of Alberta's agricultural industry. In 1989 cattle contributed $1.462 billion, or 32 per cent, to total farm cash receipts. Indeed, between 1978 and 1988 cattle contributed just over one-third of the income generated on farms in Alberta.

Historically, cattle finishing was scattered in farm feedlots across the province. However, in the last two decades, there has been a noticeable diminution of cattle feeding and processing in northern Alberta and seemingly increasing concentration of these activities in southern Alberta.

The sentiment of a visible number of northern Alberta cattle producers is that provincial government expenditures on irrigation has altered their perceived natural competitive advantage in favour of southern Alberta. The rationale for their argument is as follows. Northern Alberta has a surplus of feed grains and forages. As well, it has a substantial and growing cow herd, and ample water supply. In contrast, southern Alberta is a feed deficit area that greatly depends on supplemental irrigation water. Moreover, southern Alberta imports feeder cattle and calves, and increasingly, these cattle feeders successfully compete with their northern counterparts for northern calves and feeder cattle.

The movement of cattle feeding to southern Alberta is also being accompanied by a sharp decline in processing capacity in northern Alberta and a substantial concentration of processing capacity in southern Alberta. With the future of the Gainers Packing Plant in Edmonton in question, northern Alberta could be left without a major beef slaughtering facility.

These alarming trends have prompted Northerners to connect the substantial public investment in irrigation with the lowering of input costs to the point where northern cattlemen have great difficulty in competing with southern cattlemen in finishing and marketing their cattle. Because of these concerns northern cattlemen successfully introduced two resolutions at the December 1988 Annual Meeting of the Alberta Cattle Commission (ACC) in Calgary. The two resolutions directed the ACC to ask the Alberta Government to study (1) its past and present drainage and flood control programs and (2) its past and present irrigation development programs, to determine what effects these programs had on the growth and location of cattle production, feeding and processing in Alberta and Canada.

1.2 Objectives of the Study

Alberta Agriculture reviewed the ACC resolutions and felt they were overly restrictive. By focussing solely on government soil and water management expenditures, the results could potentially be biased. After subsequent discussions with ACC, it was agreed to proceed with a study which would examine all of the factors which might have significantly influenced the growth and development of the cattle industry in Alberta.

Specifically, the main objectives of the study were the following:

1. To identify and measure the influence of those factors which have significantly influenced the regional growth and development of cow-calf production in Alberta; and

2. To identify and measure the influence of those factors which have significantly influenced the regional growth and development of the cattle feeding industry in Alberta.

1.3 Sources of Data

Growth and development of an industry such as cattle by its very nature occur over a considerable period of time. To reflect this time element, this study depended heavily on secondary sources of information. The main sources of information included Statistics Canada "Census of Agriculture for Alberta", Alberta Agriculture "Agriculture

Statistics Yearbook", Alberta Agriculture "Agricultural Statistics", Agriculture Canada "Livestock and Meat Trade Report", Agriculture Canada "Inspected Livestock Slaughter for Alberta", Canadian Wheat Board initial prices, Alberta Forestry Lands and Wildlife carrying capacities and grazing lease acreages, Alberta Environment expenditures on irrigation, Prairie Farm Rehabilitation Administration expenditures on irrigation, Irrigation Secretariat reports on irrigation expenditures, Alberta Grain Commission feed grain prices, Alberta Agriculture Irrigation Resource Management Division and Alberta Environment irrigated acreage statistics, Alberta Agriculture "Livestock Identification and Brand Inspection", Climatological Data Base and Alberta Agriculture "Agricultural Real Estate Value" reports.

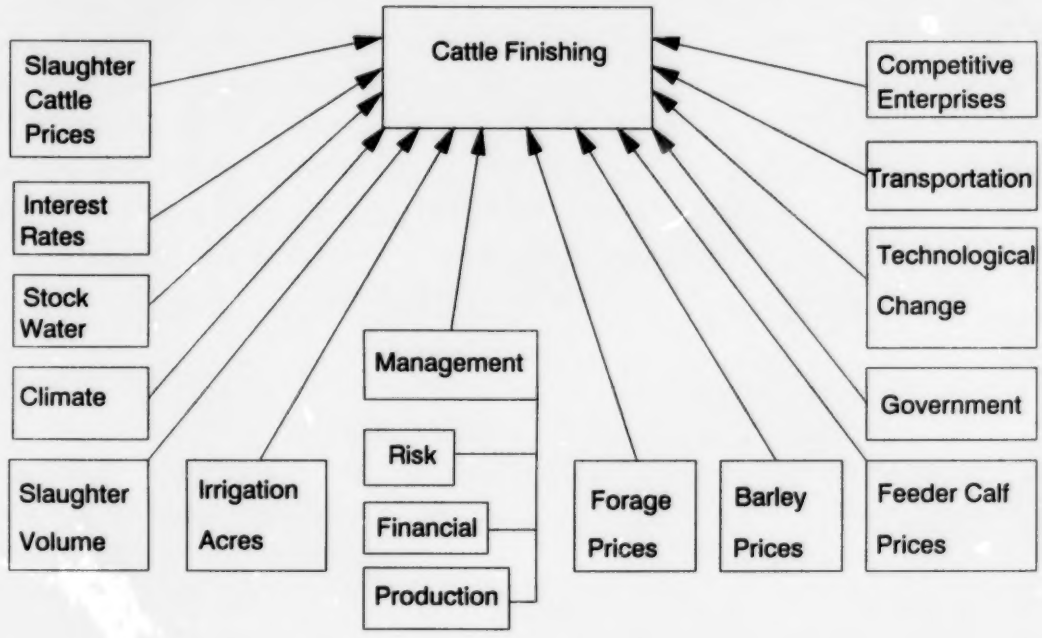
In addition to the secondary data, research staff interviewed selected feedlot operators in northern and southern Alberta to obtain information specific to their cattle operation and their views on the past, present and future of the industry. Government and industry officials were also consulted regarding evolution and further growth of cattle production and processing.

1.4 Approach to the Study

Specific but varied perceptions are held by producers across the province concerning the forces driving the regional growth and development of the beef cattle industry in Alberta. Through the ACC resolutions, Alberta cattlemen appear to be seeking validation of their perceptions via an objective and conclusive process.

The statistical segment of the study employed a disciplined set of procedures to identify those factors exerting significant influence on the regional growth and development of the cow-calf and finishing components of the Alberta beef industry. This process involved the development of hypotheses according to *a priori* knowledge of the industry and testing these hypotheses through statistical procedures. Figure 1.1 illustrates the conceptual approach to the analysis.

Figure 1.1: Conceptual Framework for Cow-Calf and Slaughter Cattle Production



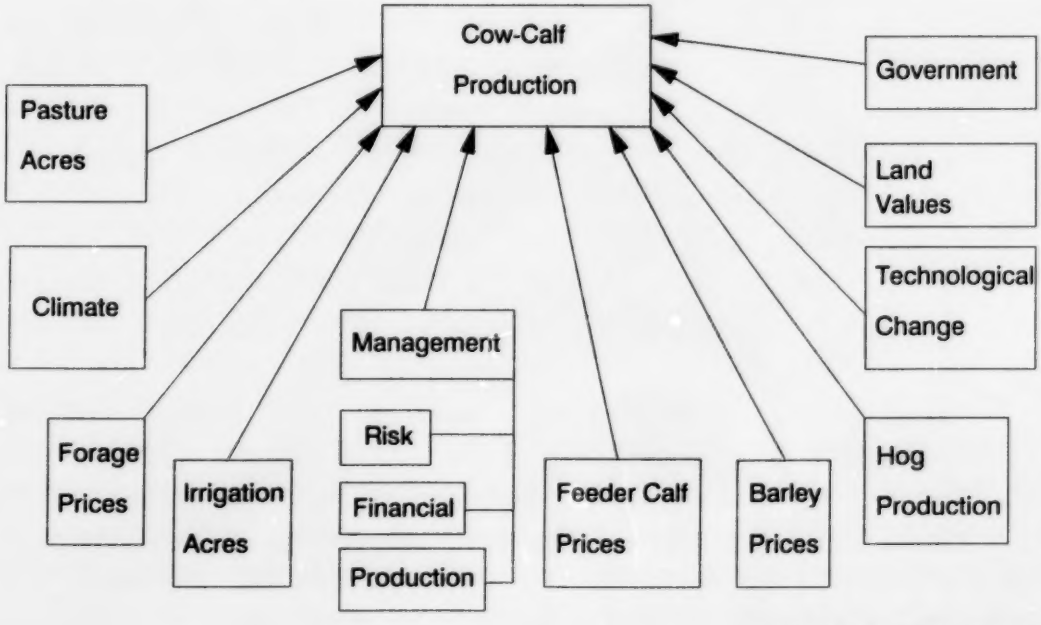


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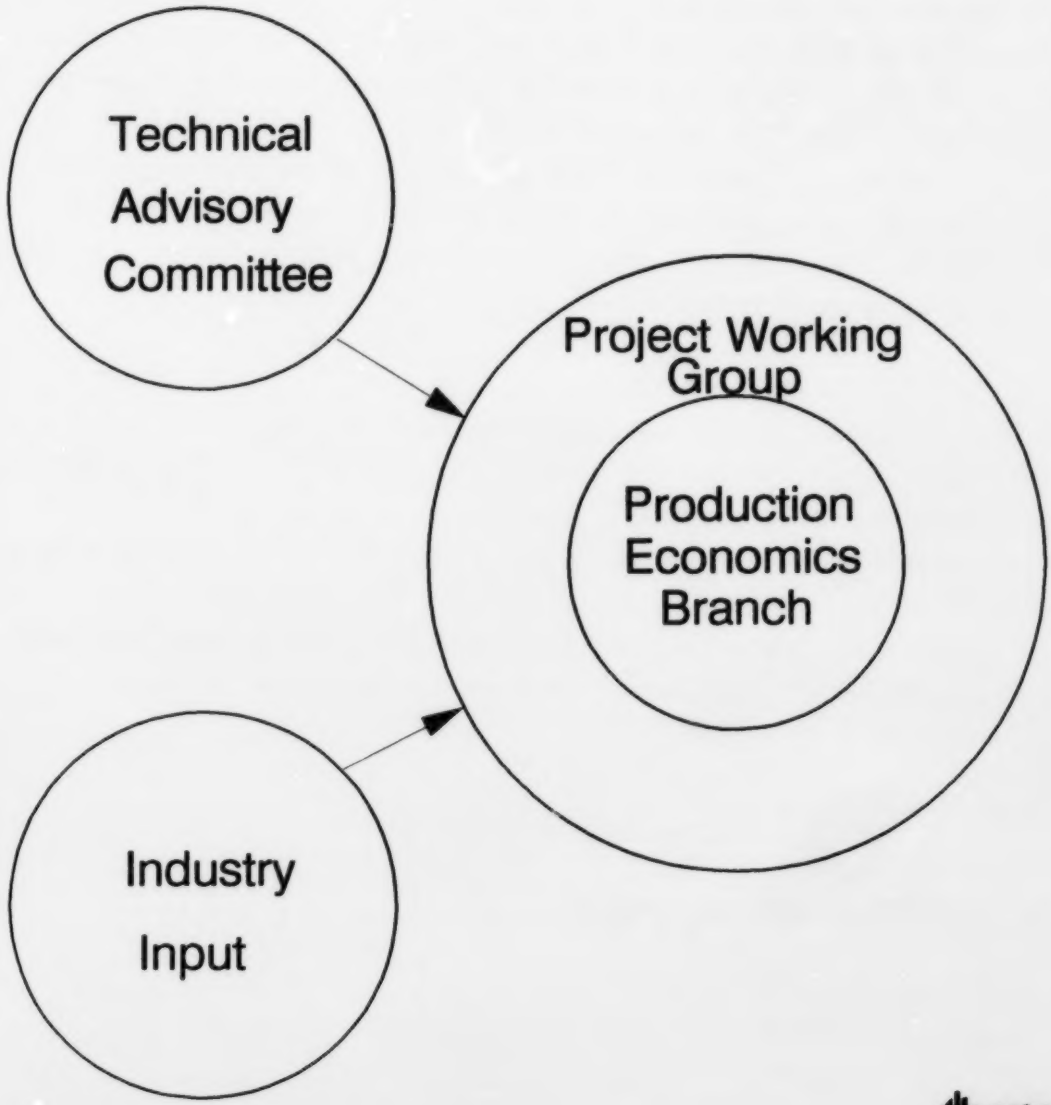
Figure 1.1 illustrates several of the hypotheses tested. It assumes that all factors are potentially related to either slaughter cattle and cow-calf production. Those factors which were expected to have a direct influence on the two variables were treated as such in the statistical analysis. Those expected to have indirect influence were linked through a series of equilibrium relationships.

A field interview survey was undertaken to complement the statistical analysis. Interview results were considered to be invaluable in validating data and formulating and testing hypotheses. Equally important, the interview process was expected to provide some descriptives for those unquantifiable factors, which might have influenced regional growth and development of the beef cattle industry. Factors were treated as unquantifiable (unmeasurable) where the appropriate data were not available. The organization of the study is illustrated in Figure 1.2.

1.5 Outline of Report

Chapter I provides the background for the study and the study objectives. Chapter II contains a profile of cattle production in Alberta. This profile is preceded by a brief description of cattle production in the United States. The underlying economic theory and frame work for analysis are reviewed in Chapter III. Results of the empirical analyses are presented in Chapter IV, followed by the results of the field interviews. Finally, a summary and the main conclusions are given in Chapter VI.

Figure 1.2: Project Organizational Framework



II. CATTLE PRODUCTION IN ALBERTA

2.1 The United States Experience

Alberta is a small part of the North American beef cattle industry. Before discussing cattle production in Alberta, it would be useful to quickly review the trends established in the larger US market.

The United States beef cattle industry has grown significantly since the turn of the century. The number of beef cows on farms in the U.S. climbed from 10 million head in 1930 to a peak of 45.7 million head in 1975. Since 1975, cow numbers have been trending downward due partly to declining per capita beef consumption and depressed feeder cattle prices. The January 1, 1990 inventory indicated that there were 33.7 million beef cows on farms, 0.7 million more than 1988, but at practically the same population as 1967.[1]

The January 1, 1990 inventory also revealed that approximately 950,000 farms had beef cows. Of those farms reporting, 92.6 per cent had fewer than 100 beef cows corresponding to 52.5 per cent of the total beef cow herd. Farms with 100 to 199 beef cows had 16.4 per cent of the total beef cow herd, farms with 200 to 499 beef cows 16.6 per cent, and farms with 500 or more cows 14.5 per cent. Alternatively, 0.5 per cent of the farms with beef cows possessed 14.5 per cent of the total herd, 2.7 per cent of all beef cow farms had 31.1 per cent, and 7.4 per cent of the total had an accumulated share of 46.5 per cent.[2]

Within the past decade concentration in the cow-calf industry has changed marginally. In 1980, 84.2 per cent of the smallest producers (less than 100 head of cows and calves) had 32.4 per cent of the cattle and calves, while 1.6 per cent of the largest producers (more than 500

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[1] United States Department of Agriculture, *Agricultural Statistics*, (Washington: U.S. Government Printing Office)

[2] Chuck Lambert, *Changes in Beef Industry Structure*, comments to the Great Plains and Western Outlook Conference, July 31, 1990.

head) had 29.6 per cent. By 1990, 82.3 per cent of producers with less than 100 head had 30 per cent of cattle and calves, and 1.7 per cent of producers with more than 500 head had 31 per cent. Similarly, there was little change in geographic concentration of the beef cow herd during the 1980's. In 1990 the 11 states with the most beef cows accounted for 58 per cent of the total beef cow herd. Sixteen states reporting beef cows had 71.1 per cent of the total herd.

By far the largest beef cow population is found in Texas with 15.8 per cent of the total herd, followed by Missouri 5.9 per cent, Oklahoma 5.6 per cent, Nebraska 5.2 per cent, South Dakota 4.5 per cent, Kansas 4.1 per cent and Montana 4.0 per cent. California had 955,000 beef cows, 2.8 per cent of the total beef cow herd.

Southeastern states, with their small holdings and plentiful supply of grass, lend themselves well to cow-calf operations. Calves and feeders are hauled as far as New Mexico and California for feeding.

Three different phases of beef production are recognized in the U.S.: cow-calf, stocker/grower and feedlots. Calves are traditionally kept for 6 to 9 months by which time they weigh 500 to 600 pounds. Having achieved this weight, the calves are either retained for backgrounding or sold as stockers. In backgrounding on cow-calf farms or as stockers, the calves are placed on a roughage ration until they reach 700 to 800 pounds. Forty to 50 per cent of feeder cattle come from cow-calf farms, while 50 to 60 per cent are initially purchased as stockers through auction markets.

Prior to World War II, cattle were fed in small farm feedlots. These family farms had small cow herds which took advantage of available grazing, forage and labour to raise and background their calves for finishing in their feedlots. Farm feedlots were an integral part of a diversified farming system which invariably included cropping and other livestock. The mix of enterprises utilized all of the farm resources and lent stability to overall farm income. The fed animals matured in about 3 to 4 years.

Since World War II, the cattle feeding business has undergone considerable change in terms of location and type or size of enterprise. The adoption of hybrid corn and sorghum expanded the acreage of these crops, as well as increased yields, producing an ample supply of feed grains and stover (stubble). Cattle and hog feeding significantly increased in the midwest due to the increased quantity of available feed. The hybrid feedgrains also expanded the traditional feed grain production region and the regional comparative advantage of feeding. With irrigation, areas outside the cornbelt could competitively produce grain for feeding.

A study done by Thompson noted that despite the abundant supply of feed in the midwest, the very first large feedlots in the United States initially appeared in the state of California[1]. They began to emerge in those areas of the state which had an abundance of forages and other feeds. In addition to the plentiful supply of forage, a substantial portion of the grain fed was purchased from other states. As the expansion of these large feedlots slowed in California, intensive feeding operations began to emerge in the High Plains region. This expansion first began in eastern Colorado and later spread to the southern High Plains of Oklahoma and northwestern Texas.

Since 1960, cattle feeding has continued to move from traditional corn belt and sun belt states to the central plains, i.e. the western corn belt and the high plains. In 1980, 13 states marketed 87.5 per cent or 23 million of the total fed cattle marketed. Between 1978 and 1982, Texas, Nebraska, Kansas, Iowa and Colorado produced two-thirds of the fed cattle marketed. The 1982 beef shipments originated mainly in Nebraska (17%), Texas (17%), Kansas (13%), Iowa (11%), Colorado (8%), California (6%), Illinois (5%) and Oklahoma (3%). By 1987, the share of fed cattle marketed by the first five states listed above declined from

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[1] G. B. Thompson, "The Future of Cattle Feeding," in *The Feedlot*, 3rd ed. by G. B. Thompson and C. C. O'Mary (Philadelphia: Lea & Febigier, 1983), p. 228.

66 per cent to 63 per cent.[1] However, the share of marketings from Texas, Nebraska and Kansas rose from 47 to 50 per cent. States such as California and Iowa which were prominent in feeding are declining in importance. The shift to the plains states was facilitated by the expansion of new varieties of milo, irrigated grain production, primarily corn, and packer location. Increasing irrigation pumping costs in the southern plains was a key factor in the emergence of feeding in Nebraska.

Feedlots purchase 700 - 800 pound feeder cattle or heavy calves, and feed them a grain based ration to 1,100 to 1,250 pounds. These feedlots exhibit a high degree of concentration. In 1962, feedlots with one-time capacity of 1,000 head or more marketed 35 per cent of the fed cattle. By 1982, these lots marketed 68 per cent of the fed cattle. In 1988, 84 per cent of the 23 million fed cattle marketed in the 13 states originated in feedlots of at least 1,000 head one-time capacity. The 200 largest feedlots which represent 0.5 per cent of all feedlots, produced 50 per cent of the cattle fed in the U.S. Presently, approximately 20 to 30 per cent of the fed cattle come from feedlot-owned growing operations, five to nine per cent from feedlot-owned cow-calf operations and about four to five per cent from packer owned feedlots. The remaining 56 to 71 per cent of the fed cattle come almost entirely from custom feedlots (and to a small extent from feedlots unaffiliated with any other phase of beef production).

Packer feeding has declined from seven per cent of the fed cattle market in the 1960's to 4.2 per cent in 1980 and has since risen to five per cent in 1987.[2] Grain companies such as Cargill and Continental own

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[1] USDA, *Agricultural Statistics*.

[2] D. G. Johnson, J. M. Connor, T. Josling, A. Schmitz and G. E. Schuh, *Competitive Issues in the Beef Sector: Can Beef Compete in the 1990s?*, Humphrey Institute Report No. 1, (Minneapolis: Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, 1989), p. 107.

some of the largest feedlots.[1] Feedlots sell 90 per cent of their finished cattle directly to packers, five per cent to auction markets, two per cent to terminal cash markets and about three per cent is internal to the packer. In 1965, the shares were 42 per cent direct, 31 per cent terminal, 19 per cent auction, and eight per cent internal. About one-third of the cattle are sold on a "hot carcass weight" basis compared to 11 per cent in 1965.

As the cattle feeding industry expanded, the packing industry followed the cattle and together, they were able to mutually exploit economies of large scale production. These state of the art plants slaughtered only beef cattle instead of the customary mix of livestock. They outperformed the older plants by operating on relatively lower margins and very high volumes. The location of the plants within the vicinity of high throughput feedlots enabled the packers to readily purchase most of their fat cattle from a small number of feedlots concentrated in a few selected areas. Of equal importance, packers were able to purchase large volumes of uniform cattle to better meet market specifications of grade and weight. It also became economically feasible to ship truckloads of uniform cattle over great distances.

The degree of concentration of beef production greatly increases as we move from cow-calf, to feedlot, to slaughtering plants and is highest at the processing level. Concentration of the beef packing industry has increased, partly due to mergers and acquisitions. In 1977, 25 per cent of beef shipments came from the four largest packers, and 36 per cent from the eight largest. By 1987, concentration increased to where 74 per cent of beef shipments came from the four largest packers and 92 per cent from the eight largest.[2] In 1988 the four largest packers slaughtered 70 per cent of the fed cattle and produced 82 per cent of

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[1] *Ibid.*, p. 72.

[2] *Ibid.*, p. 77.

the total U.S. boxed beef.[1] With increased concentration and larger plant sizes, there has been a decline in the number of steer and heifer processing plants, from 807 in 1972 to 435 in 1985. During this time period, the number of plants slaughtering 500,000 or more animals per year increased from 3 to 17 and accounted for 53 per cent of the steer and heifer marketings.

The packing industry is currently dominated by three giants, IBP, Excel and ConAgra. They slaughtered over 60 per cent and boxed 75 to 80 per cent of the fed cattle in 1987. The largest plants owned by these packers are fully integrated slaughter and boxing operations.

Initially, the development of irrigation greatly expanded feed grain production and hence cattle feeding in the southwestern feedlots. However, the increased feed grain production of the 60's slowed in the 70's due in part to increasing irrigation pumping costs. The increased feed cost reduced the feed grain price advantage which southwestern feedlots enjoyed prior to the expansion phase of cattle feeding.

Irrigation in the High Plains, and western Kansas and Nebraska, enabled farmers to substitute corn and sorghum for wheat and summerfallow. Consequently, there was an abundance of feed in these areas. Given this abundance of feed and favorable taxation laws, the cattle feeding industry was able to attract outside capital which helped to intensify cattle feeding activity. At the same time, the backgrounding industry moved west and south taking advantage of extensive grazing of winter wheat pastures during the fall and winter months. All of these factors contributed to cattle feeding shifting to the Great Plains, especially the High Plains region of Nebraska, Texas, Kansas and Colorado.

It bears noting that availability of feed grains alone did not explain past changes in the location of cattle feeding activities.

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[1] *Ibid.*, p. 107.

Large scale commercial cattle feeding developed in California despite the necessity of importing 80 per cent of the feed used. Feeder cattle were also imported from neighbouring states. California has since slipped from its position as the state with the highest number of cattle on feed, but still ranks sixth behind Texas, Nebraska, Kansas, Colorado and Iowa.

A number of other factors had a bearing on the changes in cattle feeding. The population changes of the 70's in Texas, California and Florida contributed to increasing feeding activity in these three states. Increased export demand for feed grains in the 1970's drove up the relative price of feed grain in those areas of the Corn Belt that have easy access to river transportation linked to the export trade. It followed that the export market partially eroded the feed grain price advantage associated with cattle feeding in the Corn Belt, and livestock feeding did not achieve as much prominence in this high feed production area.

The high Plains region including Texas, Oklahoma, Colorado, western Kansas and western Nebraska has a recognized feeding advantage with its mild climate, low rainfall, low humidity and relative absence of mud problems. The altitude and low humidity reduce the summer night temperatures. The availability of irrigation water is a significant determinant. Long distance from cheap water transportation insulate local feed grain prices from the vagaries of export demand. Managerial ability, risk taking and knowledge of cattle feeding have also contributed to the evolution and concentration of cattle feeding in these areas. All things considered, Thompson states, "Perhaps the most important advantage of the intensive cattle feeding areas and the large volume operations of the west is the market advantages associated with their size and the relatively new large efficient packing plants located nearby."[1]

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[1] G. B. Thompson, *The Feedlot*, p. 289.

2.2 Cattle Production in Alberta

Cattle feeding in Alberta is a small part of the highly competitive North American cattle feeding industry. Within Canada, Alberta is the largest beef cattle producing province. As shown in Figure 2.1, Alberta held 40.7 per cent of the 1988 Canadian beef cow herd, which is slightly above its 1956 share of 38.9 per cent. Its share of Western Canadian beef cow herd is more pronounced and fairly stable at 48 to 49 per cent (Figure 2.2).

Over the years the Alberta beef cow herd exhibited the same 10-year growth cycle so characteristic of the North American (beef cow) herd. Despite this cyclical growth pattern of expansion and liquidation, over time, the Alberta beef cow herd has steadily increased from 981.4 thousand head in 1956 to 1.645 million in 1988. Indeed, the cow herd peaked in 1975 at 2.19 million head, thus illustrating Alberta's potential to produce cattle.

The province was divided into three production areas based on census divisions. Production Area I contains Census Divisions (CDs) 1, 2, 3 and 5, Area II CDs 4, 6/9, 7 and 8, and Area III CDs 10, 11, 12, 13, 14 and 15. Historically, the beef cow herd tended to be concentrated in the south of the province. The 1956 Census of Agriculture shows that the southern Census Divisions (Area I) held 34.2 per cent of the herd, 40.3 per cent was located in the central CDs (Area II), with the balance (25.5 per cent) situated in the more northerly CDs (Area III). (See Figure 2.3 and 2.4 for CDs and Areas.) Since 1956, there has been a noticeable shift in the geographical distribution of the beef cow herd. The 1988 cattle population statistics indicate that the southern areas have experienced a decline in the percentage share of the provincial beef cow herd to 23.7 per cent, while the central portion of the province has declined marginally to 36.3 per cent over this 22 year period (Figure 2.5). In contrast, the share of the beef cow herd in CDs 10 through 15 has risen dramatically to 40.0 per cent of the provincial beef cow inventory.

Figure 2.1: Shares of Beef Cow Inventories

Canada

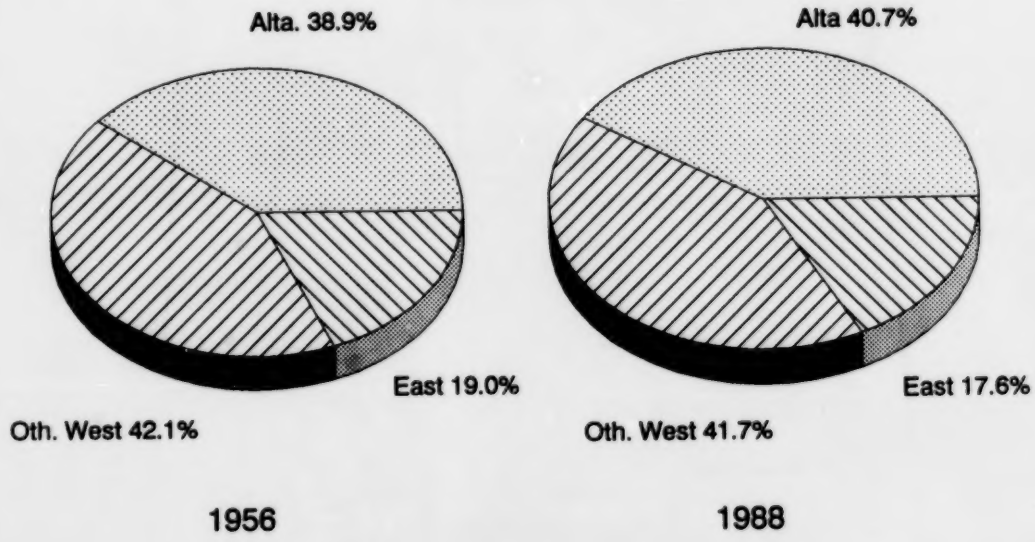

Figure 2.2: Shares of Beef Cow Inventories

Western Canada

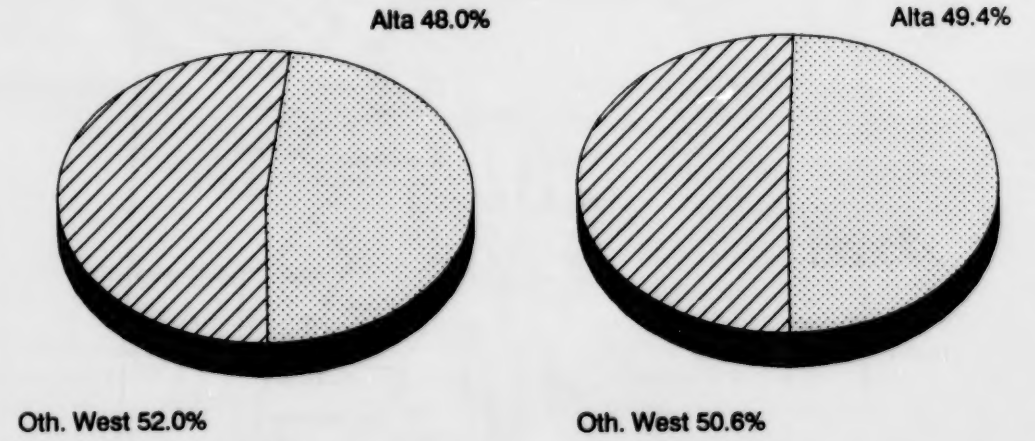

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Figure 2.3 - Alberta Census Divisions

Figure 2.4:
Study Areas
Province of Alberta

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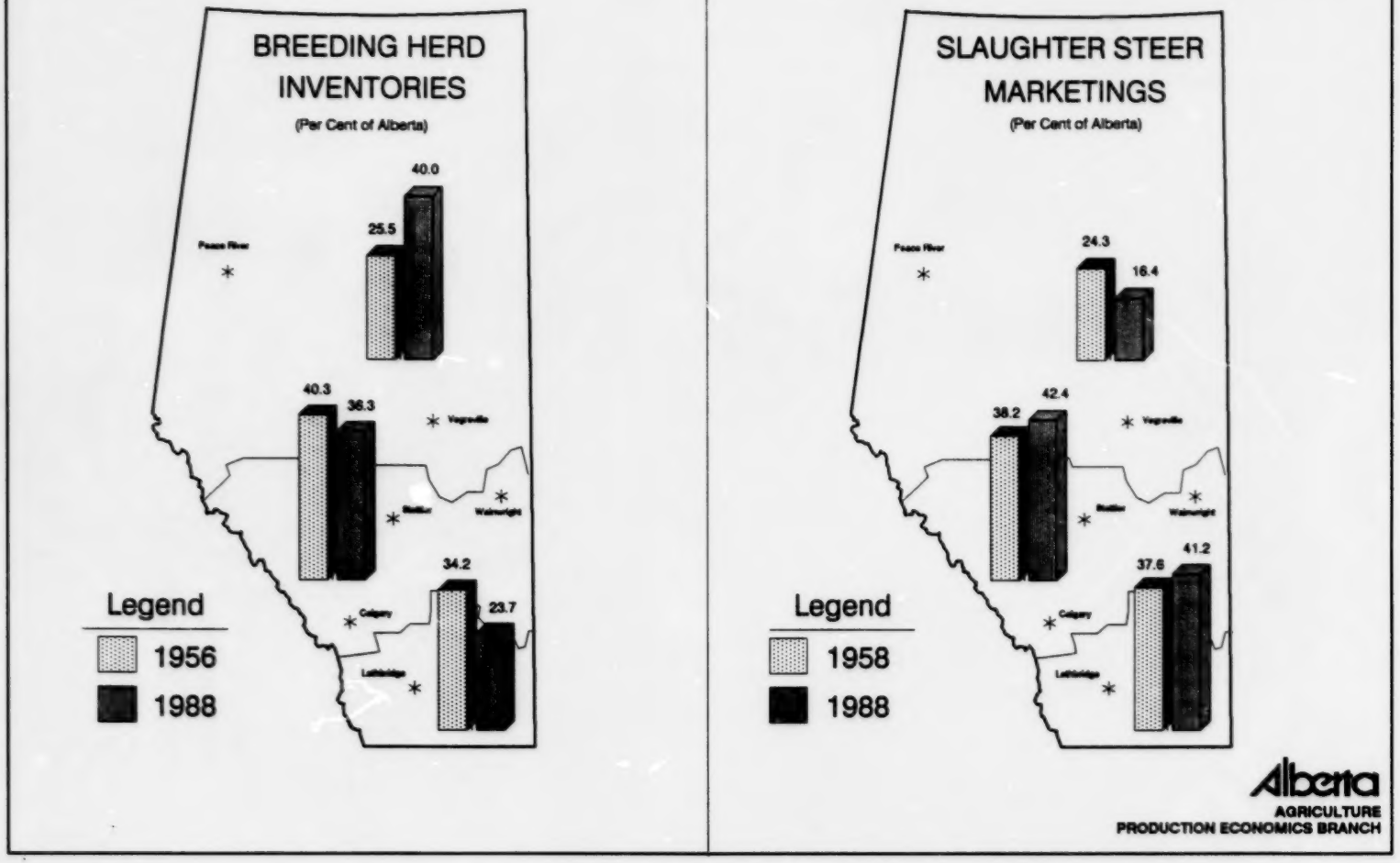
FIGURE 2.5: Shares of Alberta Breeding Herd Inventories and Slaughter Steer Marketings

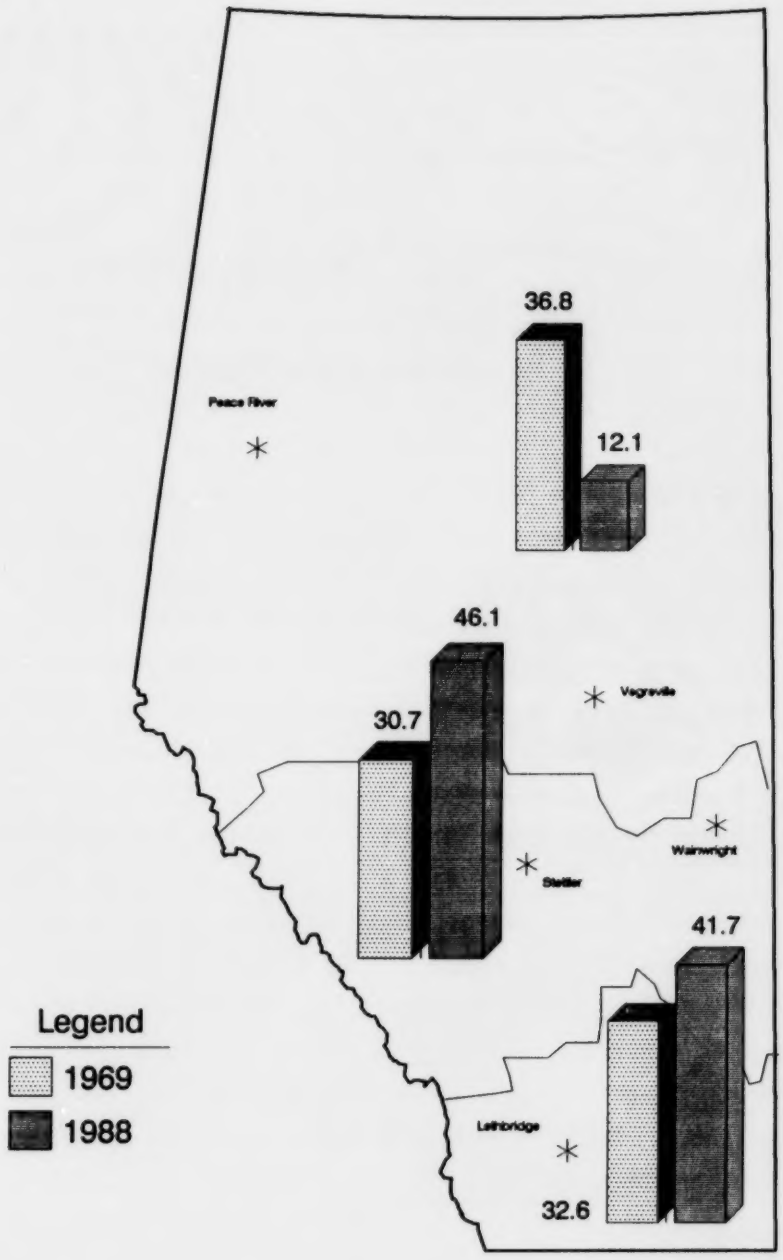


As with cow numbers, slaughter steer marketings have steadily increased from 279 thousand head in 1958, to 698.7 thousand head in 1988. Initially, the pattern of marketings was reasonably spread across the province in close correspondence with the beef cow herd population. Southern and South Central CDs were each responsible for approximately 38 per cent of provincial steer marketings while the northern CDs produced 24.3 per cent of Alberta's slaughter steers. By 1988, marketings noticeably shifted, especially to CD 2, where the share doubled from 14 per cent in 1958 to 28.9 per cent in 1988. Overall, the geographical distribution of provincial shares of slaughter steer marketings during 1988 was as follows: 41.2 per cent in Southern CDs 1, 2, 3 and 5; 42.4 per cent in Central CDs 4, 6/9, 7 and 8; and 16.4 per cent for Northern CDs 10 through 15. This shift in slaughter cattle production is highlighted in Figure 2.5.

Changes in the cattle population and the geographical distribution of cattle within Alberta were also accompanied by significant changes in Alberta's processing capacity and kill volumes. Between 1969 and 1988, cattle slaughtered at federally inspected plants in the province rose 42 per cent, from just over 860 thousand head to 1.225 million head. At the same time, cattle slaughterings noticeably shifted from northern Alberta to southern Alberta. For example, in 1969, approximately 37 per cent of the slaughterings took place in CDs 10-15, 31 per cent in CDs 4, 6/9, 7 and 8, and 32 per cent in CDs 1, 2, 3 and 5 (Figure 2.6). By 1988, however, CDs 4, 6/9, 7 and 8 recorded 46.1 per cent of the federally inspected slaughterings, and CDs 1, 2, 3 and 5 increased to 41.8 per cent. In contrast, slaughterings dropped by two-thirds to 12.1 per cent in CDs 10-15. Incidentally, practically all of the slaughterings at federally inspected plants in the far south occur in CD 2; its share of slaughterings climbed from 26.2 per cent in 1956 to 41.7 per cent in 1988. Similarly, CDs 6/9 share rose from 24.6 per cent to 33 per cent during the same time period.

Figure 2.6: Shares of Alberta Slaughter Volume

(Per Cent of Alberta)



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Between 1969 and 1988, the number of federally inspected slaughtering plants doubled from 15 to 29 plants. The plants in CDs 1, 2, 3, and 5, CDs 4, 6/9, 7 and 8, and CDs 10 to 15 also doubled to 5, 15 and 10, respectively. Despite the increase in number of plants, concentration was quite evident over the same time period. Eight of the largest federally inspected processing plants slaughtered 75 per cent of the finished cattle in 1970. By 1988, seven of the largest plants slaughtered almost 99 per cent of the fed cattle slaughtered in Alberta.

Using data from the 1985/86 Alberta Crow Benefit Offset Program, nearly 10,000 cattle feeders were classified by size of operation. The tabulation showed that 1.23 per cent of those farms marketing 2,500 head or more per year, fed 50 per cent of the provincial total. Cumulatively, the 2.73 per cent annually marketing 1,000 head or more fed almost 61 per cent of the cattle. At the other extreme, the 74 per cent marketing fewer than 100 head fed only 13 per cent of the total cattle finished in 1985/86. These statistics were not broken out by geographical area.

From a provincial perspective, Alberta is more than self-sufficient in feed grain and forage production. It is this abundant supply of affordable feed and forage which supports the cattle industry. Feed grains produced include barley, feed wheat, mixed grains and oats. Forage is obtained mainly from hay, silage (cereal, legume/grass and, to some extent, corn), greenfeed, straw and pasture (native, tame and aftermath). Of the 51.04 million acres devoted to agriculture, 7 million acres (13.7 per cent) were planted to wheat in 1988. It is not clear from statistics how much of the wheat produced was used as feed. Barley, the major feed ingredient in cattle feed, is the second most widespread grain grown in Alberta. It occupied 4.7 million acres last year. Oats occupied 1.45 million acres, mixed grains 175 thousand acres, grain corn 10,000 acres and fodder corn 19,000 acres.

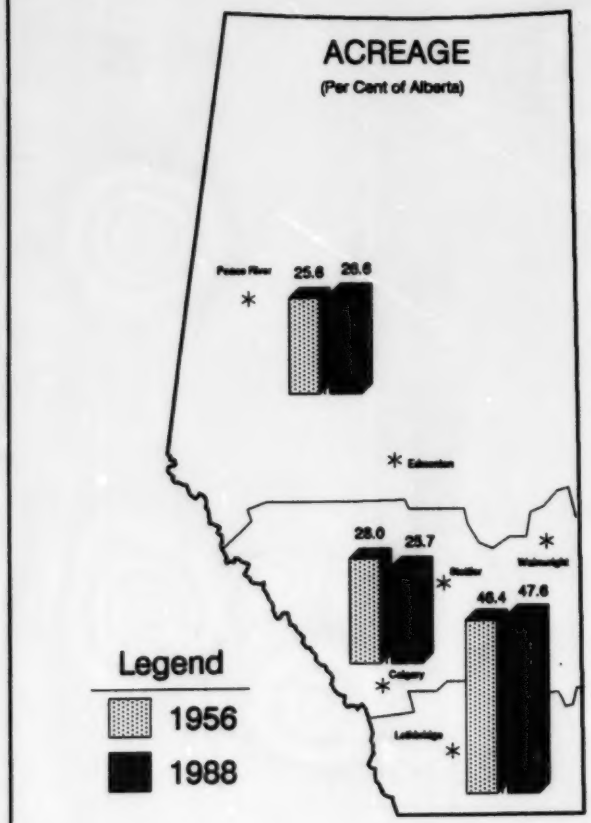
Over 47 per cent (24.2 million acres) of the total agriculture acreage in Alberta is devoted to pasture. Tame hay was grown on 4.65 million acres.

Figures 2.7 through 2.9 offer a snapshot of major grain acreage and production by Census Divisions. Wheat is grown more extensively in the south of the province. CDs 1, 2, 3 and 5 accounted for 47.6 per cent of the acreage and 44.5 per cent of production in 1984-88 (Figure 2.7). In contrast to wheat, most of the barley is produced in the northern half of the province. Almost 80 per cent of the 1988 barley acreage was situated in north central (31.4 per cent) and northern (47.1 per cent) Alberta (Figure 2.8). As with barley, oat acreage was concentrated in central and northern Alberta with 26.9 per cent found in CDs 4, 6, 7 and 8 and 66.2 per cent in CDs 10 through 15 (Figure 2.9). Only a small proportion (21 per cent) of the total barley acreage was found in CDs 1, 2, 3 and 5. In terms of production, over 50 per cent of the barley produced in the period 1984 - 1988 originated in northern Alberta, 31 per cent came from CDs 4, 6/9, 7 and 8, and 18 per cent in CDs 1, 2, 3 and 5.

Tame hay and pasture are critical sources of roughage for the cow herd, backgrounding and finishing enterprises. The 4.65 million acres of tame hay produced roughly 10 million tonnes of hay in 1988. CDs 10 - 15 accounted for nearly 65 per cent of this acreage and over 60 per cent of the 1984-88 production. In the 1956-60 period, these northern CDs had 47.1 and 50.9 per cent of the total tame hay acreage and production, respectively (Figure 2.10).

Alberta has in excess of 24 million acres of pasture, 14 per cent of which is designated as improved. Southern Alberta (CDs 1, 2, 3 and 5) contains 29.6 per cent of the total pasture acreage but only 8.1 per cent of this regional acreage is characterized as improved. In contrast, northern Alberta (CDs 10 through 15) has 37.9 per cent of the total pasture acreage, 19.4 per cent of which is described as improved. Indeed, 51.8 per cent of the total improved pasture is found in this northern region with a further 31.2 per cent found in the central portion of Alberta (Figure 2.11). When irrigated pasture is excluded,

FIGURE 2.7: Shares of Alberta Wheat Acreage and Production



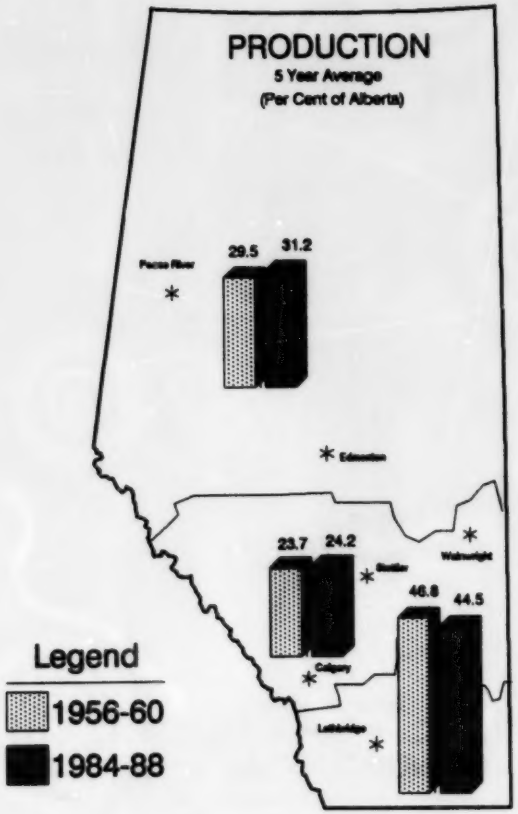


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FIGURE 2.8: Shares of Alberta Barley Acreage and Production

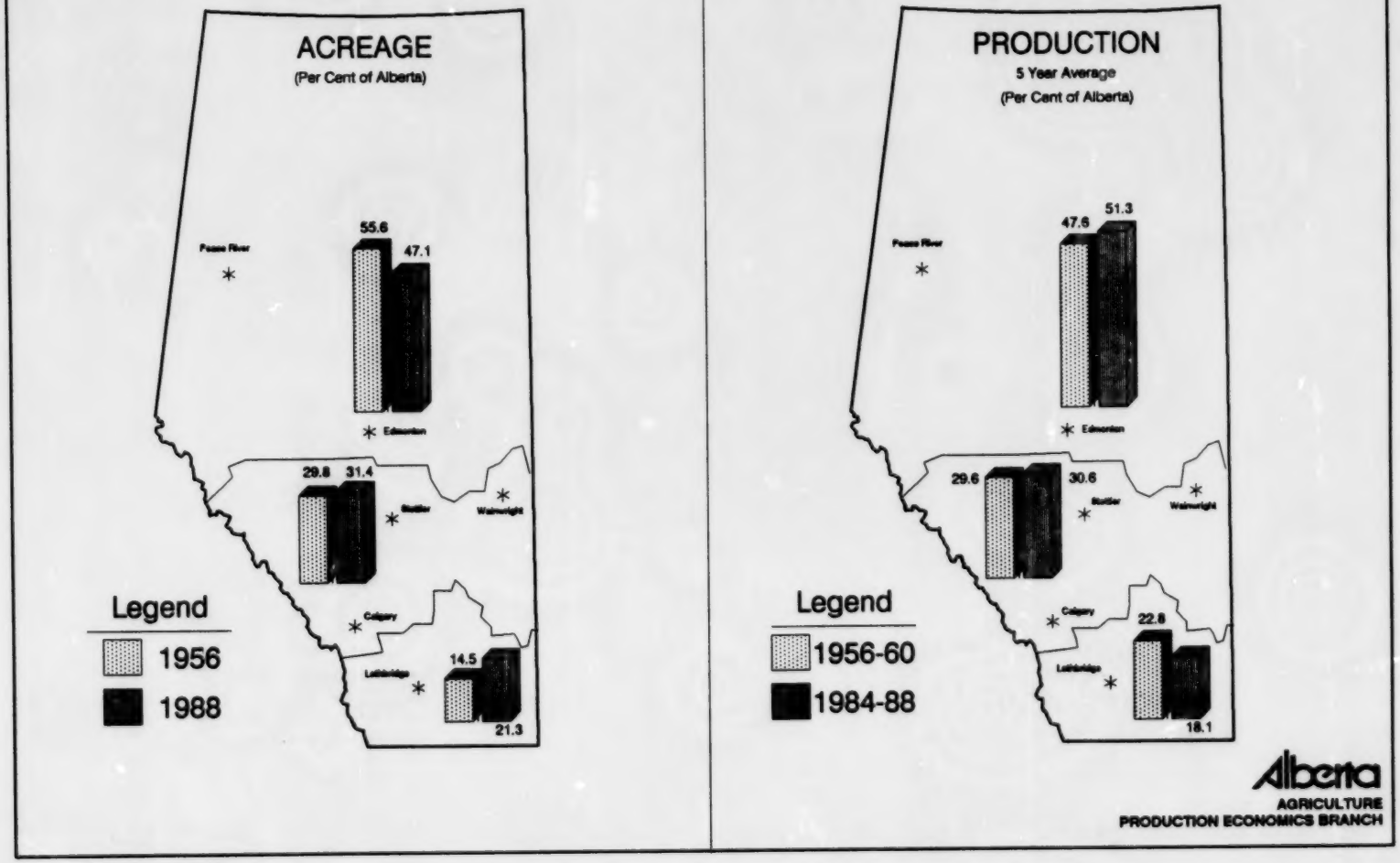


FIGURE 2.9: Shares of Alberta Oats Acreage and Production

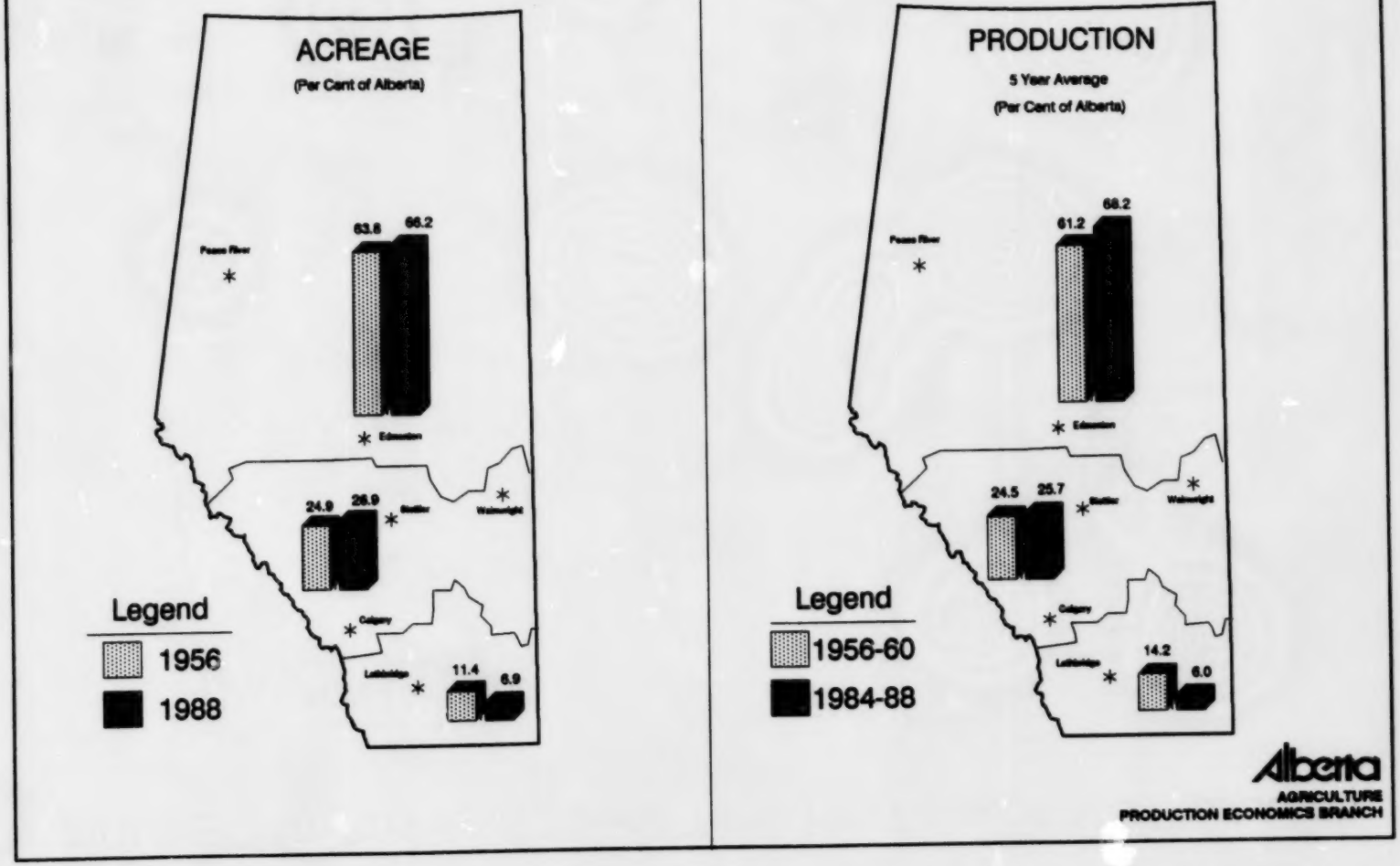


FIGURE 2.10: Shares of Alberta Tame Hay Acreage and Production

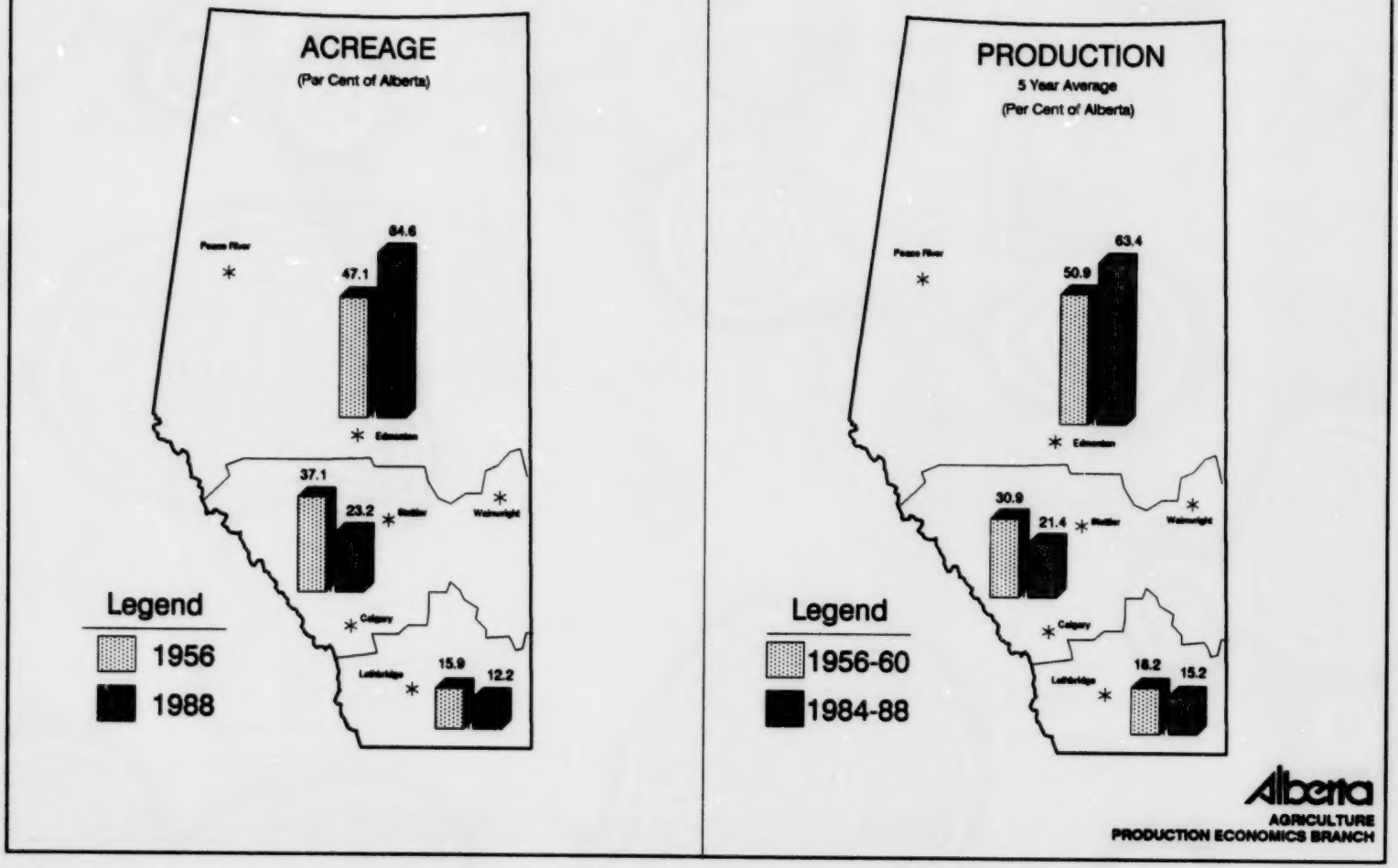
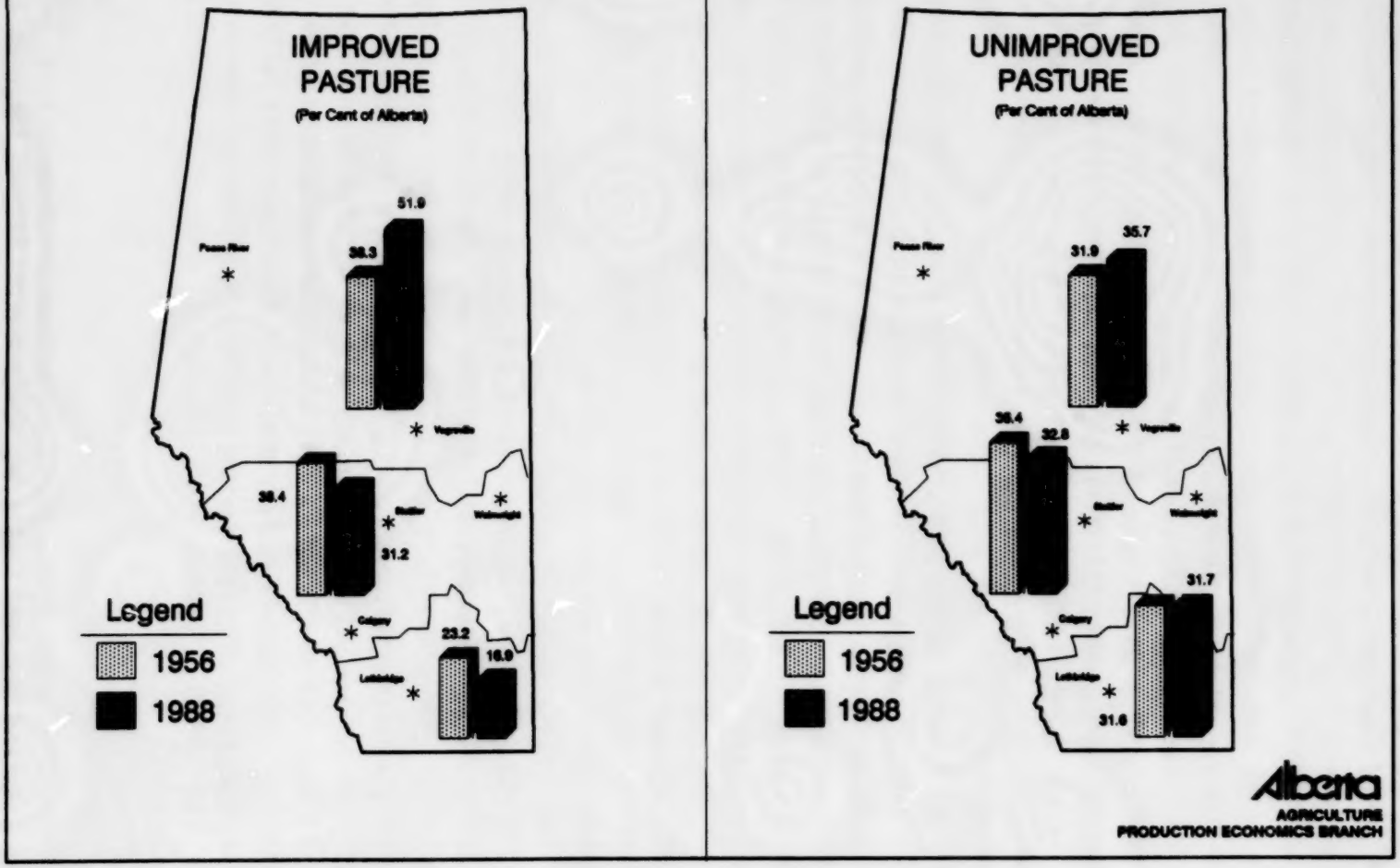


FIGURE 2.11: Shares of Alberta Improved and Unimproved Pasture



the carrying capacity of the improved pasture in the northern half of the province is about four times greater than that of southern Alberta.[1]

Southern Alberta has a long history of irrigation dating back to the late 1800's. Irrigated acreage increased over time with a major expansion initiative occurring after 1970. Between 1930 and 1960, irrigated acres expanded from about 350,000 acres to 600,000 acres. Irrigated acres fluctuated around 600,000 until 1973, at which time a major expansion initiative occurred increasing acreage irrigated to 1.05 million by 1988. Substantial public funds were invested in irrigation rehabilitation during the 1970's and 1980's.

Prior to the 1970's the majority of acres were irrigated by surface (flood) irrigation systems. Side wheel role and center pivot systems were adopted in the 1970's and 1980's, replacing most of the surface irrigation. The Eastern and Bow River Irrigation Districts are the only larger districts that still have sizeable surface irrigated acres. The Taber, Lethbridge Northern, and St. Mary River Irrigation Districts irrigate almost entirely using pressure systems. The use of pressure systems allowed additional acres to be irrigated that could not be irrigated by surface systems.

The period of irrigation expansion (1973 to 1988)closely followed the collapse of international grain markets in the 1960's. But most of the expansion in feeding activity in southern Alberta occurred during the 1960's and into the 1970's. Between 1960 and 1977, provincial slaughter marketings doubled from with half of the increase occurring in CD 2. Irrigation was already well established in the older irrigation districts in CD2 before this cattle feeding expansion. The implication is that factors other than irrigation were also critical to the expansion of cattle feeding activity.

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[1] Alberta, *The Beef Cow-Calf Manual*, (Edmonton: Alberta Agriculture,Beef Cattle and Sheep Branch, Revised 1989), p.112.

Irrigation is found almost exclusively in southern Alberta where it plays a vital role in providing water for municipal, industrial, and crop and livestock uses. Most of the irrigation works is managed by 13 Irrigation Districts. Approximately 1.34 million acres were irrigated in 1988, including 230,000 acres that were outside the Irrigation Districts. This 1988 acreage represented an increase of 220 per cent over the 1956 acreage. Cereal grains comprised 44 per cent of the 1988 irrigated acreage, hay occupied a further 31 per cent, other fodder 4 per cent, and sugar beets and specialty crops the remaining 21 per cent.

Southern Alberta is extremely dry. Irrigation has helped transform this semi-arid area into a highly productive region. Irrigation with its assured supply of good quality water, has greatly reduced the risk associated with crop production on farms. Silage (corn and cereal) has emerged as a valuable cash crop in irrigated areas. Many of the large feedlots depend on silage for roughage in their feeding rations. Cereal (barley) silage returned a gross margin (i.e. return over variable production costs) of $253.64 per acre in 1988 compared to $219.19 per acre for soft white wheat and $155.91 per acre for barley grain [1]. As well, irrigated silage yields are significantly greater than those observed on dryland, and year to year yield variability is substantially reduced. Consequently, the large feedlots are now utilizing irrigated barley silage for roughage and grain barley for energy. This assured supply of irrigated silage and the easy access to barley grain both within and outside the irrigated regions are believed to be major contributors to the increasing cattle feeding concentration in southern Alberta.

Statistics on silage acreage are not very reliable. Not all Irrigation Districts report the acreage. As a result, what is reported underestimates the extent of silage production. The available statistics suggest that irrigated silage currently (1988) comprises

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[1] Production Economics Branch, Alberta Agriculture, 1988 and 1989 field cost and returns survey data.

about 3.6 per cent of total irrigated acreage versus about 2.5 per cent for the 1974-1978 period. At least 33,400 acres are irrigated for silage production.

The importance of irrigation to reducing production risk can be illustrated by comparing crop production in 1988, a drought year, and 1989. Production Economics Branch farm survey estimates reported that 1988 irrigated barley yields of 85 bushels per acre was 6 bushels or 7 per cent below 1989 yields.[1] In contrast, 1988 dryland barley yield of 18 bushels per acre was only 45 per cent of the 1989 crop. And so while irrigated barley posted net income gains of 48 cents per bushel in 1988, dryland barley had estimated losses of 72 cents per bushel. With adequate moisture in 1989, dryland barley showed net income gains of 13 cents per bushel versus estimated losses of 17 cents per bushel for irrigated barley. As with irrigated grain barley, estimated irrigated barley silage yield in 1988 was down only 5 per cent from 1989 yield levels.

Irrigated crop yields are higher than dryland crop yields in southern Alberta and elsewhere in the province. However, the economics favour dryland crop production in central and northern Alberta. The 1989 production economics farm survey estimates show barley yields of 60 bushels per acre in the Vermilion area versus 91 bushels from irrigation. With two-thirds of the yield of irrigated barley, Vermilion survey farms broke even, whereas irrigated barley experienced losses of 17 cents per bushel in 1989. Similarly, 1988 silage yield per acre in Vermilion was two-thirds that of irrigated silage. Despite the lower yield, the lower production cost enabled Vermilion area farmers to report net income of $10/tonne versus $9/tonne for irrigated farms. Cost-returns estimates for central Alberta also reveal a decided

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[1] Ibid.

economic advantage over irrigated barley and irrigated silage production in southern Alberta.[1]

Irrigation also plays a vital role in cattle feeding by providing a very good supply of high quality drinking water for livestock. Farmers within the Irrigation Districts are entitled to domestic and stock water. This irrigation water is available from about mid-April through to September. Therefore sufficient storage capacity is only required to supply water during the cool months of the year, i.e., from October until the following spring. Relatively small storage dugouts of sufficient capacity are constructed alongside the canals, where they can be readily filled by gravity.

In those areas of southern Alberta which do not have access to irrigation or permanent sources of water, feedlots may be confronted with far less reliable sources of stock water. Many of the natural water sources do not flow year round. Consequently, replenishment of on-farm storage facilities may depend upon the brief spring run-off which, in itself, can be highly variable. A 20,000 head feedlot can use more than 250,000 gallons of water per day depending on the temperature. Storage capacity is of necessity larger and more expensive. A general rule of thumb is that dugouts which depend on natural runoff should have a minimum storage capacity of two years supply of water. By this rule, dryland dugout construction cost is at least 3.4 times as great as that of irrigation, i.e. $35.26 per head versus $10.32 per head. The drylands of southern Alberta contain a diminishing number of feedlots which tend to be small. Moreover, with the absence of a good year-round supply of stock water, these feedlots have limited capacity to expand.

Manure disposal is somewhat easier and less expensive on irrigated land. The increased moisture and high temperatures facilitate rapid decomposition. Therefore, with the greater capacity of the irrigated

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[1] Ibid.

crop to extract large amounts of soil nutrients, waste disposal on irrigated crop land is both practical and feasible.

In contrast to southern Alberta, the north of the province is not constrained by moisture for crop growth and stock watering. Manure disposal may be more problematic and excessive moisture can contribute to severe mud problems. Accordingly, choice of feedlot site is critical to the availability of water as well as the mitigation of mud problems. The mean annual temperature in the northern half of the province ranges from 2 to 4 degrees Celsius versus 6 to 7 degrees Celsius in the south. This lower temperature in the north is accompanied by less daily temperature variability. Dust storms are not common and feedlot dust problems are not as significant as in the southern drier environment.

The views regarding the effects of climate on the performance of cattle in Alberta are contradictory. This debate will only be resolved by research aimed at determining the impact of the natural environment on feedlot cattle in different parts of the province. Suffice it to say that with ample supplies of water, a semi-arid climate with its low humidity, and minimal mud, insect and waste disposal problems, seems very hospitable to cattle feeding. With respect to southern Alberta with its high winds, the problem of feedlot dust still persists.

Transportation has also greatly affected the location and concentration of cattle feeding in Alberta. Over the years, successive governments have created a well developed all-weather road network in rural Alberta. The expanded and improved roads and highways, and the arrival of the semi-trailers removed those constraints which tended to limit cattle feeding activity and processing to the same location as the feeder cattle. Cattle liners and refrigerated trucks markedly expanded the market area for feeder cattle, beef and processed meats, causing factors other than beef cow herds and feed to gain greater influence.

Assuming the problems of production are resolved, southern Alberta seems to have a market location advantage for cattle feeding relative to other areas in the province. It is serviced by major transportation

routes, at comparable distances to eastern Canadian markets and certainly closer to the growing U.S. market. The larger market access offers feedlots the opportunity to exploit potential economies of scale and as a result become more competitive in bidding for feeder cattle in northern Alberta, other western provinces and south of the border. In turn, processors can also benefit from economies of scale given reasonable proximity to sufficient slaughter cattle supplies and closer access to the beef and processed meats markets. The 1988 decision of Cargill to locate its 1,200 head per day (single shift) capacity plant in High River, Alberta, and the 1989 attempted merger of Lakeside Packers of Brooks and Centennial Food Corp. Ltd. tend to support this hypothesis. Yet the transportation advantage may be more apparent than real.

Alberta Agriculture transportation economists have indicated that the transfer cost associated with shipping carcasses directly from Edmonton to the Los Angeles market were lower than transporting grain and feeder cattle to Lethbridge for finishing and then shipping the carcass to Los Angeles.[1] Their estimates show a transfer cost of $59 per head finishing and slaughtering the cattle in Edmonton versus $67 per head to ship fed cattle from the Edmonton area to Lethbridge for slaughter and subsequent transport to Los Angeles. If the feeder calves and the grain are shipped to Lethbridge for feeding, and subsequent slaughter and shipment to Los Angeles, the total transfer cost is $68 per head. When shrink is taken into account the differential between slaughtering in Edmonton and shipping fed cattle to Lethbridge becomes even more pronounced (total transfer costs of $86 vs. $99). To the extent that calves and grain are purchased closer to Lethbridge area as opposed to purchasing in the Edmonton area, the transportation differential between feeding in Edmonton and Lethbridge is greatly reduced. Nevertheless, the argument suggests that strictly in terms of

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[1] Per. comm. . . K. Packer, Senior Transportation Analyst, Alberta Agriculture.

transportation costs, Lethbridge may not have the great advantage as is popularly believed.

It is essential that the entrepreneurial element be brought into the equation. As indicated earlier, cattle feeding is a highly competitive, market sensitive business. With the feedlot business characterized as high volume and low margin, it demands a high plane of knowledge regarding production practices, pricing feeder cattle and alternative marketing options.

As a group, farmers in the Irrigation Districts of southern Alberta have been perceived as being more aggressive risk takers than producers elsewhere in Alberta. Perhaps the productive stability and increased choices of enterprises accompanying or associated with irrigation enhances more risk taking. Despite the substantial total capital investments estimated in the vicinity of $1,500 per acre, and higher feed and feeder costs, area farmers have converted southern Alberta into the cattle feeding (and processing) capital of the province. These operators, therefore, must possess the entrepreneurial skills essential for success in order to survive. Such skills cover production, marketing and finance. The presence of producers with experience in intensive livestock production may have been the driving force behind the growth and expansion of cattle feeding in the area. The world grain glut of the late 1960's and early 70's simply provided the spark which triggered the burst of feeding activity. The success of these entrepreneurs was likely also enhanced by the federal Agricultural Research Station in Lethbridge and Manyberries, and a provincial government agricultural presence highly focussed on information and technology transfer.

III. ECONOMIC THEORY AND ANALYTICAL FRAMEWORK

3.1 Theoretical Considerations

The quantity of a commodity produced by a firm will depend on the price of the commodity and the unit cost of producing that quantity of the commodity. The higher the commodity price and/or the lower the cost of production, the greater will be the quantity produced. In an industry dominated by many producers of relatively equal size, all producers in a given locale will receive the same price. While prices received are the same for these firms, production costs may vary considerably due to a variety of causes including different input sources, resources, input mixes, management, environment, and government policies and programs. Firms with lower production costs are more profitable. Moreover, low cost producers can survive longer than higher cost producers, because they are in a better financial position to withstand the vagaries of the business cycle and to take advantage of growth opportunities.

Figure 3.1 shows the average cost (AC) and marginal cost (MC) of a high-cost producer (A) and a low-cost producer (B). The output could be cattle finished for slaughter. The AC curve describes the average unit cost of producing specific quantities of slaughter cattle. The MC curve describes the additional cost incurred if output is expanded by one unit. The MC curve also represents the quantity of slaughter cattle that would be supplied at a specific market price. In other words, it is the supply curve of the feedlot. The low-cost producer may have any or all of the advantages of lower input cost, lower overhead cost, lower cost technology, better management, or industry infrastructure that results in lower marketing or input procurement costs. Lower cost may also arise from specific government policies/programs. The low-cost producer (B) will supply more slaughter cattle than will the high-cost producer (A) at any given slaughter cattle price. At price, P, the lower cost producer supplies Q_B compared to Q_A for the high cost producer.

Figure 3.1: Cost Structure of Two Firms

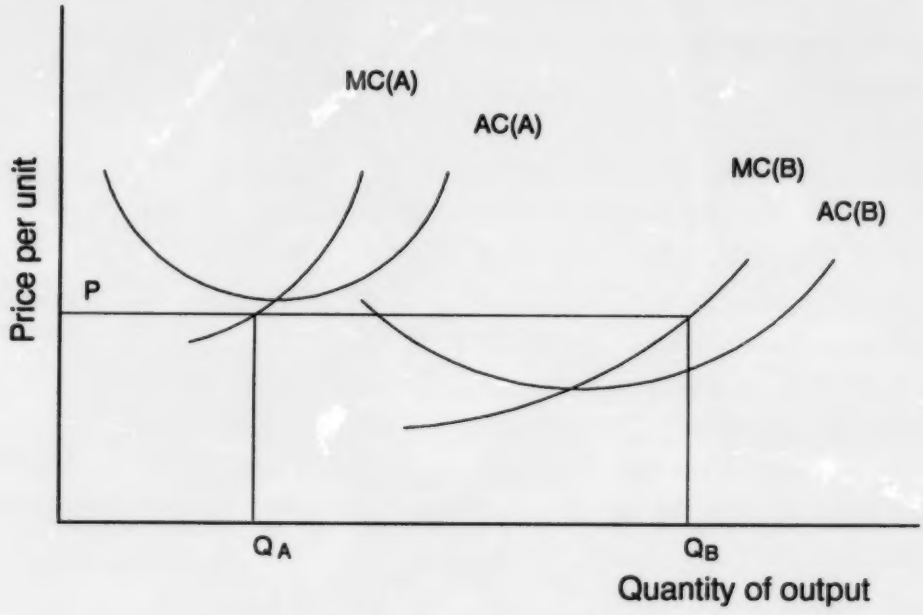
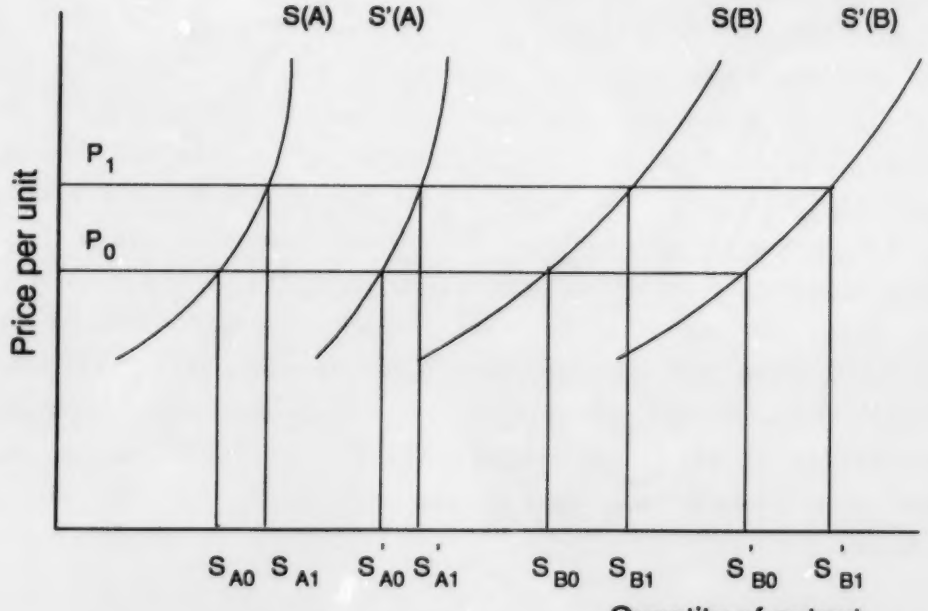


Figure 3.2: Supply Response in Two Regions



Production Economics Branch

The cost curves (Figure 3.1) can also be used to describe regional cost structures. These regional costs may be expressed as average and marginal costs of producing slaughter cattle. Region A would be the high-cost producing region and B the low-cost producing region. As shown, for any given price, production as well as profit margins in region B exceed those of region A.

The underlying causes of variations in cost structures across regions are similar to those of individual firms. Factors within a firm's control include labour, capital and management. Regional factors include the natural resource endowments peculiar to the region, such as land productivity, water availability, the natural environment, marketing opportunities, market structure of supply industries, and input availability. Policy factors would include government policies and programs which directly or indirectly affect the industry, the region, inter-related industries or public infrastructure. A region that has a better endowment mix of these factors will, as a rule, have lower production costs. However, the region that is well endowed with natural resources can lose its natural comparative advantage through those policies or programs which adversely affect that region and/or favourably affect a competing region.

The quantity of the commodity supplied can change because of regional price changes, or due to changes in any of the internal, external or policy factors that affect production costs (Figure 3.2). A change in the price of the commodity will result in a movement along the supply curve. A price increase from P_0 to P_1 will bring about an increase in the quantity supplied from S_{A0} to S_{A1} in region A and from S_{B0} to S_{B1} in region B. A reduction in the cost of production due to new technologies, lower input prices or a government program, will shift the regional supply curves from S(A) to S'(A) and S(B) to S'(B). Accordingly, at price P_0, the quantity supplied increases from S_{A0} to S'_{A0} in region A and from S_{B0} to S'_{B0} in region B. Regional supply can also shift as more (or fewer) productive resources are allocated to the production of the commodity. While this figure illustrates changes occurring simultaneously in both regions, costs and supply in one region

can change independently of changes in other regions. As well, the changes can also move in opposite directions in the two regions.

Government policy can directly affect the average cost of production in a specific region. Programs that develop irrigation infrastructure, reduce the purchase price of inputs, or increase the efficiency of input use will reduce the average cost of production. The effect is illustrated (in Figure 3.1) as a shift from average cost curve A to average cost curve B. Conversely, a regulation that increases input requirements or a policy that results in higher input prices will increase the average cost of production (a move from curve B to A). The actual size of the impact on average cost will vary with each program. Eventually, if one region is able to reduce say the cost of feeding relative to other regions, production and productive resources will eventually shift to that lower cost region, and contract in the relatively high cost producing region.

3.2 Analytical Framework

The supply of finished beef (slaughter steers and heifers) from different production areas in Alberta can be analyzed within a framework of average and marginal costs of production. Production will concentrate in those regions with lower average production and marketing costs, regardless of the cause. An analysis of the location of production must determine what factors contribute to lower production and marketing costs, and the impact of each of those factors.

The major costs of finishing cattle are feed and the feeder cattle. Other costs include veterinary and medicine, trucking, marketing, labour, machinery and equipment, bedding, water, utilities, buildings, operating loans, and overhead. Feed costs per unit of output can be lower in a region because of better feed conversion and/or because of less expensive feed. Theoretically, regional feeder calf prices depend on the supply of and demand for calves in that specific region. With the relatively easy movement of calves across the province, the calf price should be lowest in the surplus areas and higher by transport costs in the deficit areas. Trucking and marketing costs can vary

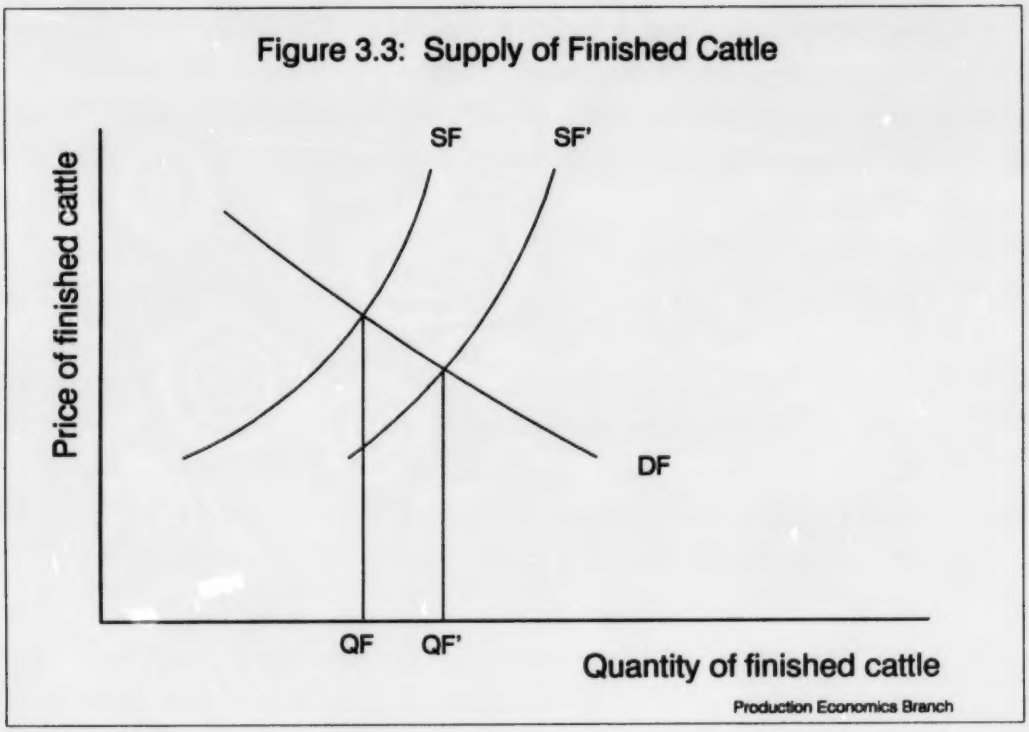
between regions depending on the source and quantity of feeder animals, and the location of feedlots and slaughter facilities. Veterinary service, medicine and building costs are affected by climatic conditions. Equipment and input supplies can be affected by the size of the industry within a region. Labour, building, machinery and overhead costs can depend on the size of the feeding operation. Bedding costs will depend on the environment and facilities, while water costs vary with the source.

Feed cost directly impacts the average cost of production, thereby affecting the quantity of cattle produced in a region. Figure 3.3 illustrates the effect of a decrease in feed costs on the supply of finished cattle. The curve SF represents the supply of finished cattle prior to the decline in feed costs and SF' is the new supply after the decline in feed costs. A decline in feed costs, everything else remaining the same, will result in a greater supply of finished cattle for any given price. A similar effect can be observed for any decline in input costs.

The effect that a change in a barley supply factor on the quantity of slaughter cattle production is illustrated in Figure 3.4. An increase in a factor that increases barley supply would result in supply shifting from I_0 to I_1 and barley price declining from P_0 to P_1 (quadrant A). The converse would hold for an increase in a factor that reduces barley supply (e.g. irrigation) from I_1 to I_0. A decrease in barley price will reduce slaughter cattle production costs and shift the supply of slaughter cattle from S_0 to S_1 (quadrant B). An increase in barley price would shift the slaughter cattle supply from S_1 to S_0. The graphs in quadrants A and B can be used to trace a barley price - quantity of slaughter cattle relationship (quadrant C). This relationship shows that as the price of barley increases (decreases) the quantity of slaughter cattle supplied decreases (increases).

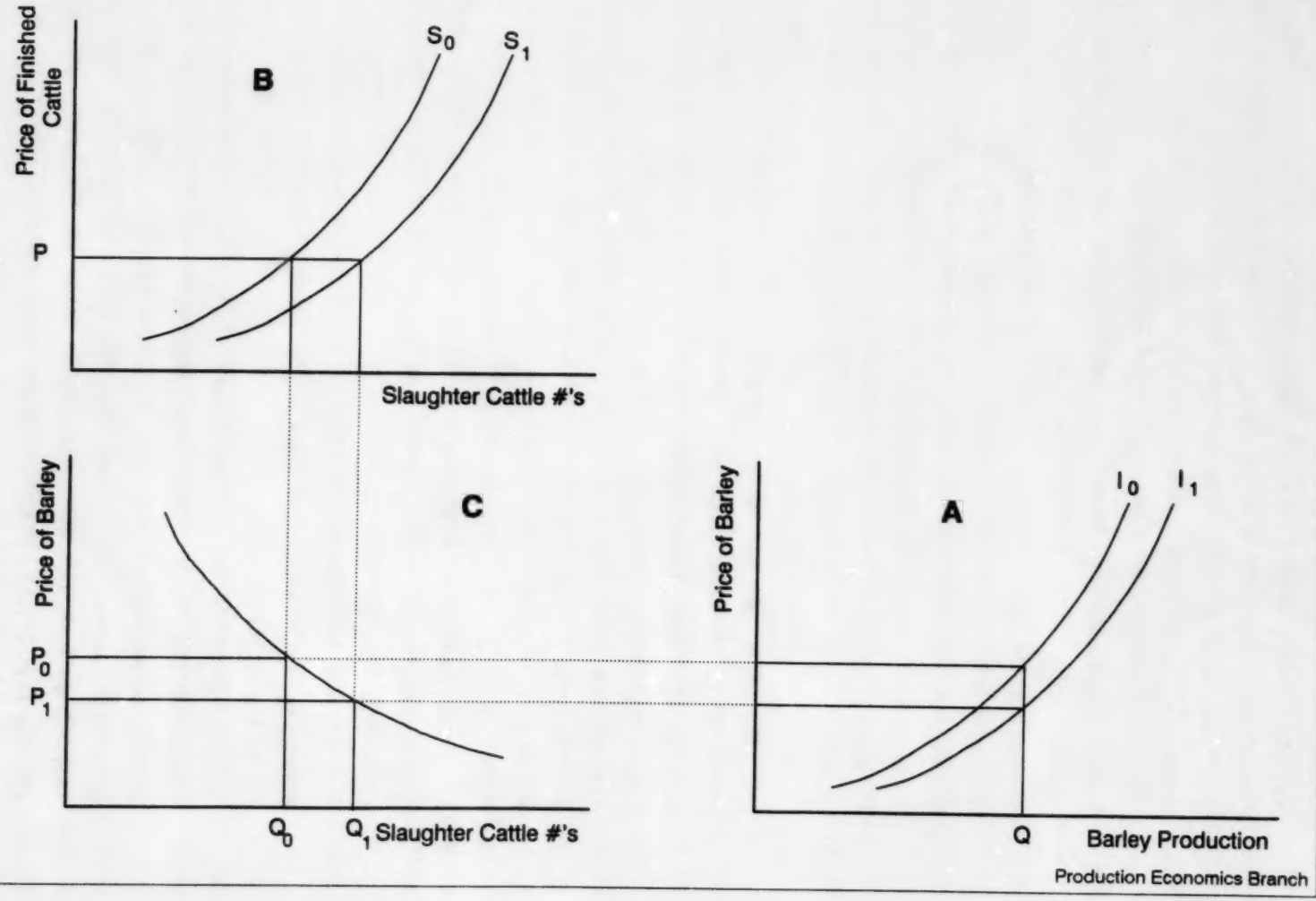
The supply of finished or fed cattle can be estimated by determining which factors affect supply and the magnitude of each effect. The supply function can be expressed mathematically as

$$YS = s(PS, PB, YC, K, X) \qquad (3.1)$$



where YS is the quantity of slaughter cattle, PS is the price of slaughter cattle, PB the price of feed, YC the beef cow herd, and K, the number of cattle (cows, calves and finished feeders) slaughtered in previous years in that area. K is a proxy for processing capacity as well as slaughter activity. X is a composite of any other variables relevant to determining the supply relation. X includes the real interest rate, price of roughage, export demand for Alberta meat, and competing production enterprises such as hogs. The variables PB, YC, K, and X will shift the supply curve. Increased PB should shift the supply curve to the left, i.e. reduce supply, while increased YC and K should shift the supply curve to the right, i.e. expand supply. The expected effect of X depends on the net effect of these variables which comprise X. Increased real interest rates, poultry meats and hog production will tend to depress slaughter cattle production, while increasing export demand for beef and processed meats will positively affect supply.

Figure 3.4: Expected Impact of Irrigation on Slaughter Cattle Numbers



Within a given region, the cost of feed will depend in part on the available feed supply. A region with surplus feed production will have a relatively lower feed price than a region that must import feed. The feed cost difference between surplus and deficit regions will be determined by transportation costs. Within a region, there is the ability to affect the production of feed and, therefore, the cost of feed. Increased relative profitability of non-feed crops such as canola, will attract resources away from feed production, thereby increasing the cost of feed. The introduction of new feed production technologies, such as higher yielding cultivars, will increase production and lower the price of feed. Government policies can affect production by changing the costs of inputs or by providing inputs, such as water, which hitherto were unavailable or available at prohibitive cost.

The effect of the above changes is illustrated in Figure 3.5 where curve SG is the supply of feed prior to any changes. Curve SG' is the supply of feed after adoption of a yield increasing technology. Competing crops become relatively less attractive and resources are transferred from those crops to expand feed production. Given demand for the crop of DG, the increased production will lower feed price from PG to PG'.

The supply of feed can be estimated by determining what factors significantly affect feed production. The functional form of the supply curve can be expressed as

$$YB = b\ (PB,\ PW,\ AI,\ T,\ X) \qquad (3.2)$$

where YB is the supply of feed primarily barley grain and barley silage, PB is the price of feed, PW is the price of a non-feed grain (wheat), AI is the quantity of irrigated acres, T is technology, and X is a composite of all other relevant variables such as barley stocks, crop acres, summerfallow and the weather, prior to, during and after the growing season. Increased AI and crop acres, and improvements in technology T should shift the supply curve to the right, while increased PW, barley stocks, barley silage and summerfallow acres will reduce

FIGURE 3.5

supply i.e. shift the supply curve to the left. The net effect of X is unknown. Because of higher yields, increased irrigated barley acres should increase the supply of feed. However, competitive crops will also have higher yields under irrigation and acres could be shifted from feed barley to the higher valued crop. The withdrawal of irrigated acreage from feed production may be sufficiently great to offset the increased yield per acre with a consequent reduction in overall feed production.

Figure 3.5 can be used to illustrate the potential impacts of changes in any of the production inputs. The supply and price of calves will be affected by the cost of raising calves and the returns from competing enterprises. An increase in the cow herd or an increase in calf weaning rates could be illustrated as a shift from supply curve SG to SG'.

The supply of feeder calves can be estimated by determining the supply of breeding cows and scaling the supply in direct proportion to the weaning rate. The supply of cows can be expressed as

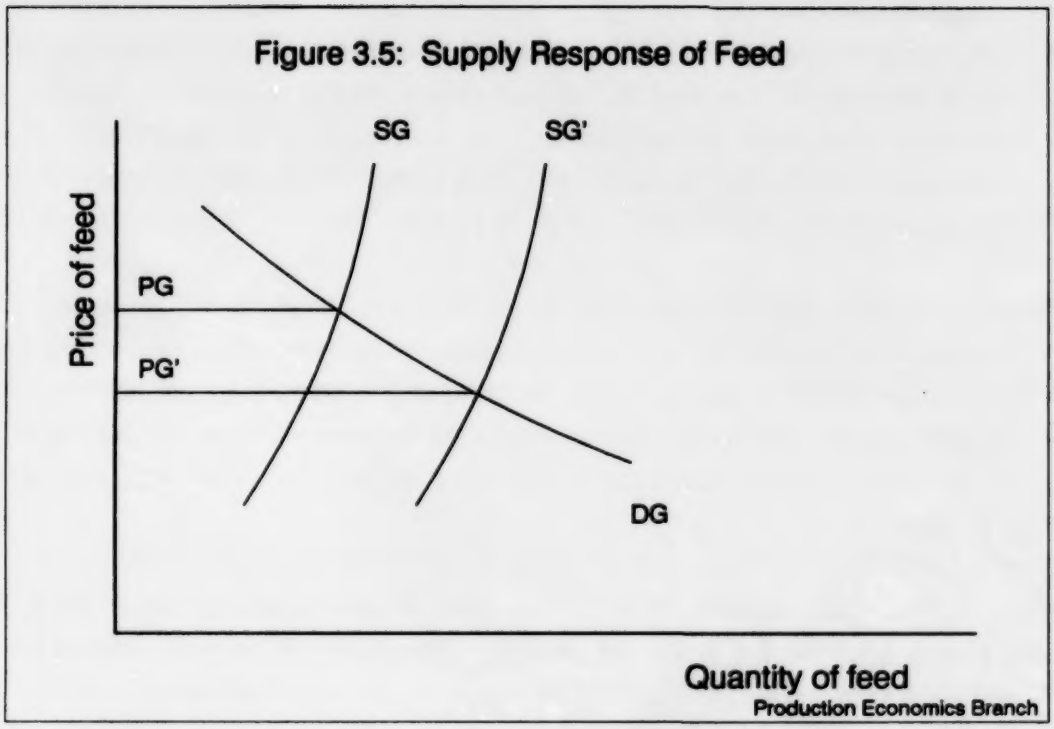
$$YC = c(PF, AP, AU, PR, X) \qquad (3.3)$$

where YC is the supply of cows, PF is the price of feeder calves, AP is acres of improved pasture, AU is unimproved land acres, PR is the price of commodities from a competing enterprise, and X is a composite of other relevant variables. Increased pasture acres will shift the supply curve of cows to the right and increased prices of competing commodities will have the opposite supply effect. Increased acreage devoted to canola, wheat and other crops will reduce available grazing and hence, the supply of breeding cows.

Pasture acreage will depend on the relative profitability of pasture (that is, calf production) compared with alternative uses. Pasture supply can be expressed as

$$AP = p(PH, PC, AI, AU, X) \qquad (3.4)$$

where AP is acres of improved pasture, PH is the price of hay and is used as a proxy for the price of pasture, PC is price of calves, AI is irrigated acres, AU is acres of unimproved land and is an indication of



the land capability, and X is a combination of factors including other alternative crops. Increased AI should reduce improved pasture acreage because of the substitution effect of higher valued crops which can be produced under irrigation; increased AU should have the opposite effect and increase improved pasture supply. An increase in the X factors should, over time, reduce improved pasture acres.

3.3 Empirical Model

The factors that affect the supply of a commodity will vary over time and from region to region. Cross sectional data, data across Census Divisions, can be used to determine differences across regions at a given point in time. Time series data, data collected over a number of years, can be used to determine how factors affect one another by examining their relative change over time.

Production relationships were estimated using Alberta Census Division data for the period 1956 to 1988. The use of Census Divisions and time series data requires a model specification that allows for behavior differences among Census Divisions over time as well as behavior over time for a given Census Division. The model can be expressed as

$$Y_{it} = B_{1i} + \sum_{k=2}^{K} B_k X_{kit}\, e_{it} \qquad (3.5)$$

where the B'_s are the parameters and are assumed constant over time. They are fixed parameters with e_{it} being independent and identically distributed with $E[eit]=0$ and $E[e_{it}^2]=o_e^2$.

This model is generally referred to as a dummy variable model because it can be written as

$$Y_{it} = \sum_{j=1}^{J} B_{1j} D_{jt} + \sum_{k=2}^{K} \sum_{j=1}^{J} B_{kj} X_{kit} D_{jt} + e_{it} \qquad (3.6)$$

where the D_{jt}'s are known as dummy variables which have values of zero or 1. Specifically, $Djt = \begin{matrix} 1 \text{ if } j=i \\ 0 \text{ if } j\neq i \end{matrix}$
The subscript i refers to the region and j refers to the dummy variable for that region, k refers to the variable used in the estimation, and t refers to the year of the time series data being considered. There is a dummy variable for each region. The dummy variable that corresponds to region i will have the value of one for those observations in region i, but will be zero for the other regions.

The specific functional forms used in the analysis are based on the relationships described in equations 3.1 through 3.4. The specification of the supply equations was altered in some cases due to insufficient data.

(1) Supply of slaughter steers and heifers was specified as

$$YS_{it} = \sum_{j=1}^{J} B_{1j} D_{jt} + \sum_{j=1}^{J} B_{2j} PS_{it} D_{jt} + B_3 PB_{it} + \sum_{j=1}^{J} B_4 YC_{it} D_{jt} + \sum_{j=1}^{J} B_5 K_{it-1} D_{jt-1} + e_{it} \qquad (3.7)$$

where YS is the quantity of slaughter cattle, PS is the price of slaughter cattle, PB is the price of feed barley, YC is the beef cow herd and K is the number of cattle slaughtered. The dummy variable, D, was included because the supply response is likely to vary from one production area to another. The use of dummy variables allows determination of regional differences in the supply response. If the difference was found to be significant the dummy variable was retained, otherwise it was dropped and the response estimated for the entire province. This equation used the supply of breeding cows in the region as a measure of calf supply and hence feeder calf price. Larger cow herd numbers will increase calf supply and reduce the cost of acquiring feeder calves.

(2) Supply of feed was assumed to be primarily affected by the supply of barley grain and silage. Feed supply was specified as follows:

$$YB_{it} = \sum_{j=1}^{J} B_{1j} D_{jt} + \sum_{j=1}^{J} B_{2j} PB_{it} D_{jt} + \sum_{j=1}^{J} B_{3j} AI_{it} D_{jt} + B_4 T_{it} + B_5 PW_{it} + e_{it} \qquad (3.8)$$

where YB is the supply of barley, PB is the feed barley price, AI is irrigated acres, T is technology, and PW is the price of non-feed wheat. Dummy variable specifications were included for barley price and irrigated acres, and as in equation 3.7, were deleted if found to be insignificant.

(3) Cow herd was estimated as a function of calf price, pasture acres and canola production, and was specified as follows:

$$YC_{it} = \sum_{j=1} B_{1j} D_{jt} + \sum_{j=1} B_{2j} PF_{it-1} D_{jt-1} + \sum_{j=1}^{J} B_3 AP_{it} D_{jt} + \sum_{j=1}^{J} B_5 PR_{it} D_{jt} + e_{it} \qquad (3.9)$$

where YC is the beef cow herd, PF is the price of feeder calves, AP is acres of improved pasture, and PR is canola production. PR is a measure of the opportunity costs of competing enterprises.

(4) Pasture acres were estimated as as follows:

$$AP_{it} = B_1 + B_2 PH_{it} + \sum_{j=1}^{J} B_{3j} AI_{it} D_{jt} + B_4 AU_{it} + e_{it} \qquad (3.10)$$

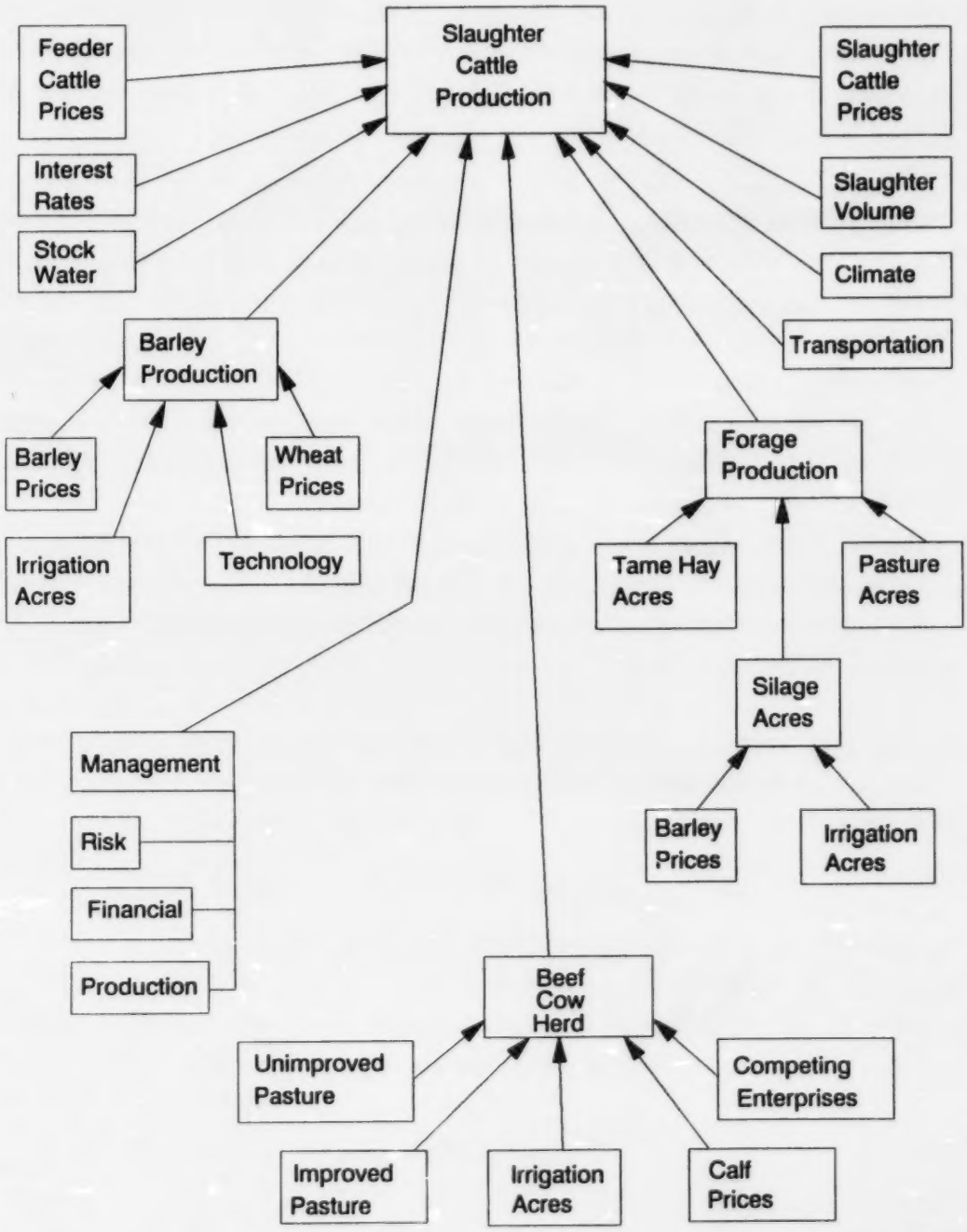
where AP is acres of improved pasture, PH is the price of hay, AI is irrigated acres, and AU is acres of unimproved land.

The B parameters are estimated coefficients. There were 14 Census Divisions (i=1,...,14) and 33 years (t=1,...,33) of data. The Census Divisions were divided into three production areas. Production Area I contained CDs 1, 2, 3, and 5, Area II, CDs 4, 6/9, 7 and 8, and Area III, CDs 10, 11, 12, 13, 14, and 15.

The impact of any of these independent variables on the supply of slaughter or finished cattle can be determined from equations 3.7 to 3.10. The effect of the number of breeding cows on finished cattle in a region can be determined directly from the parameter estimate in equation 3.7. The effect of irrigation on barley supply can be determined from the parameters in equation 3.8. The effect of irrigation on finished cattle supply will require the use of equations 3.7 to 3.10. Irrigated acres affect improved pasture acres, which in turn affect cow numbers. Cow numbers directly affect finished cattle supply. Irrigated acres will also affect the production of barley, hence the price of barley, which in turn affects finished cattle supply. The interrelationships between cattle finishing and the above factors are illustrated in Figure 3.6.

This section concludes the review of the economic theory used in the analysis and the analytical approach. Results of the analysis are presented in Chapter IV.

Figure 3.6: Conceptual Framework for Slaughter Cattle Production



IV. RESULTS OF THE ANALYSIS

4.1 Correlations of Selected Variables

The analysis first involved the examination of simple correlations among factors that were likely to have influenced the location of cattle feeding in Alberta. The simple correlation analysis was used to identify those factors or variables which were highly associated with changes in cattle feeding during the sixties and eighties. The results are displayed in Table 4.1.

Table 4.1

CORRELATION COEFFICIENTS FOR CATTLE FEEDING
AND SELECTED PHYSICAL FACTORS IN THE 1960's and 1980's

	Correlation Coefficients	
Physical Factors	1960's	1980's
Temperature	0.14	0.41*
Rainfall	0.16	-0.15
Distance to U.S.	-0.54*	-0.62*
Farm Size (Fed Cattle)	0.69*	0.92*
Farm Size (Cows)	0.12	0.18
Processing Capacity	0.54*	0.85*
Cow Population	0.78*	0.35*
Barley Production	0.55*	0.18
Irrigated Acres	0.28*	0.83*
Pasture Acres	0.77*	-0.03
Crop Acres	0.38*	0.09

* Significant at 5 per cent confidence level. 70 d.f.

A higher (lower) correlation in the 80's as compared to the 60's indicates that the identified factor is more (less) important in cattle feeding now than 30 years ago. For instance, by observing the temperature and rainfall coefficients, cattle feeding seemed to have

shifted over the years to a dryer and warmer climate i.e. southern Alberta. This partial correlation analysis suggests (or confirms) that over the years, cattle feeding has shifted from cow-calf farms and farm feedlots located in the cooler wetter areas of the province where barley and pasture are plentiful, to larger feedlots in the warmer, drier, irrigated areas which have access to processing facilities. In the 1960's, cattle were fed on smaller farms, close to the cow-calf and barley growing areas. By the 1980's cattle feeding shifted away from the barley growing and grazing areas with high cow populations to the irrigated south. The farm size correlation suggests that cattle feeding has become more concentrated on large cattle feeding farms and in areas with greater access to irrigation and processing facilities.

It should be pointed out that these correlation results are only indicative of an association. They do not specify any causal relationship, but simply measure the degree of association between two independent variables. This measure enables the analyst to identify those variables which are significantly related to the variable(s) under examination.

4.2 Model Results

The equations given in Chapter III were estimated using pooled Census Division and time series data for the period 1956 to 1988. Data were compiled by the 15 Census Division in Alberta[1]. These 15 Census Divisions were grouped into three production areas based on similar geographic and productive characteristics, and test results from the estimated equations (see Figure 2.3). Dummy variables were used to determine if regional differences existed in the parameter estimates. If regional differences were not present then a provincial estimate was obtained.

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[1] The Census Divisions used were the pre-1986 Census Divisions. After 1986 the number of Census Divisions were increased from 15 to 19.

4.2.1 Supply of Slaughter Steers and Heifers

The final supply estimates for slaughter steers and heifers for the Census Divisions in the three production areas are presented in Table 4.2. Higher slaughter steer prices resulted in increased numbers of steers and heifers finished for slaughter in Areas I and II. The increase was three times as great in Area I than Area II. *Ceteris paribus*, a $10 per cwt increase in slaughter steer price resulted in an increase in feeding activity of 8,000 head in Area I and 2,670 head in Area II, but a 1,010 head decline in Area III. The negative results in Area III suggest that as fed cattle prices increase, these feedlot operators are less aggressive bidders for feeder cattle than their counterparts in Areas I and II in the southern half of the province, especially Area I. With strong calf prices, the farm feedlots in the north are more inclined to sell the calves instead of feeding them to market weight. In contrast, producers in Areas I and II seem to be more determined than northern cattlemen to keep their pens full.

The price of barley has a negative effect on the number of cattle finished for slaughter. Higher barley prices increase the cost of feeding for slaughter and reduce the number of steers and heifers demanded for finishing throughout the province. There was no difference in the effect across production areas, so a provincial estimate was determined. A $10 per tonne increase in barley price *ceteris paribus*, reduced the number of steers and heifers finished for slaughter by 1,500 head.

The potential supply of feeder calves, as represented by the beef cow herd, has a positive effect on the number of animals finished for slaughter. A plentiful supply of calves would depress calf prices, and hence stimulate feeding activity. The impact of the beef cow herd on slaughter steers and heifers was greater in the south, Areas I and II, than in northern Alberta, Area III. A 1,000 head increase in the beef cow herd caused an increase in slaughter cattle numbers of 603 in Area I, 499 in Area II and 345 in Area III.

Table 4.2

ESTIMATES OF SUPPLY FUNCTIONS BY PRODUCTION AREAS IN ALBERTA

Function and Variables	Parameter Estimates Area I	Area II	Area III
1. Slaughter Steers and Heifers ('000 head)			
Intercept	-39.26*	-21.37**	4.38
Slaughter steer price ($/cwt)	0.799*	0.267*	-0.101*
Barley price ($/tonne)	-0.150*	-0.150*	-0.150*
Beef cow herd ('000 head)	0.603*	0.499*	0.345*
Cattle slaughtered (t-1)('000 head)	0.580	0.240	0.099
$F(12,435) = 318.3$ $R^2 = 0.898$			
2. Barley Production ('000 tonnes)			
Intercept	-245.76*	-18.35	-123.87*
Barley price ($/tonne)	0.255*	0.557*	1.909*
Wheat price ($/tonne)	-0.862*	-0.862*	-0.862*
Technology (index)	462.11*	462.11*	462.11*
1/Irrigation ('000 acres)	4207.29	-126.85	-3.26
$F(10,451) = 32.8$ $R^2 = 0.421$			
3. Beef Cow Herd ('000 head)			
Intercept	33.67*	58.22***	5.53
Calf price (t-1)($/cwt)	0.115*	0.07*	0.041*
Improved Pasture ('000 acres)	0.502*	0.344	0.400
Canola Production('000 tonnes)	-0.371	0.010	-0.062
$F(11,436) = 106.1$ $R^2 = 0.728$			
4. Improved Pasture ('000 acres)			
Intercept	307.19*	307.19*	307.19*
(100/Hay price) ($/tonne)	-33.76*	-33.76*	-33.76*
(100/Unimproved land) ('000 acres)	-220.93*	-220.93*	-220.93*
Irrigation ('000 acres)	-0.079	3.633	23.850
$F(5,456) = 122.5$ $R^2 = 0.573$			

* Significant at the 5 per cent level.

** Significant at the 10 per cent level.

*** Significant at the 15 per cent level.

The last variable in the equation is volume of slaughter cattle in year t-1. This variable is an indication of slaughtering capacity and the beef processing industry infrastructure. As beef slaughtering and processing capacity increased, cattle feeding also eventually increased. The impact in Area I was nearly 2.5 times that of Area II and 6 times

that of northern Alberta. For a 10,000 head increase in slaughter and processing capacity, there is a subsequent increase in cattle feeding of 5,800 head in I, 2,400 head in II, and 990 head in III.

The estimated equations indicate the major factors affecting the number of slaughter steers and heifers produced in each area and how changes in these variables would affect slaughter numbers. Increasing slaughter prices will result in finishing shifting to Area I and to a lesser extent Area II, from Area III. Barley prices would have a similar inverse effect on fed cattle numbers in all areas of the province. An expanding cow herd would result in increased finishing in all regions, but relatively more so in the south. Expanded cattle slaughterings (capacity) would have little impact in northern Alberta but will greatly expand finishing in Area I, which already has a substantial processing capacity.

Silage was dropped from the model because of insufficient production data. Nevertheless, the included variables accounted for 90 per cent of the variation in slaughter cattle production. Moreover, barley price which is included in the model, is a significant determinant of silage values.

Regional supply elasticities are given in Table 4.3. These measures provide a more direct statement of proportional change in slaughter steer and heifer numbers in response to changes in a given factor. Elasticity is defined as the percentage change in one variable due to a one percentage change in another variable. A one per cent increase in the slaughter steer price will increase slaughterings by 0.35 per cent in Area I and 0.15 per cent in Area II, and reduce slaughterings by 0.18 per cent in Area III. The elasticities with respect to the barley price as well as the beef cow herd are lowest in southern Alberta. On the other hand, the supply response with respect to cattle slaughtering and processing capacity significantly increases as production moves from north to south.

4.2.2 Barley Supply

Supply estimates for barley for the three production areas are given in Table 4.2. The effect of barley price on barley production is positive in all regions. In Areas I and II the parameter estimates are not statistically different from zero. This indicates that the price of barley does not have much of an effect on barley production in these two Areas, where barley production is an essential part of the cropping rotation. Barley production in northern Alberta is much more responsive to barley price changes, indicating that producers in this region are more price sensitive and will likely alter barley plantings and crop inputs in response to price changes. All things remaining equal, a $10 per tonne increase in barley price will stimulate only a 2,550 tonne increase in barley production in Area III, but a 19,090 tonne production increase in Area III. Higher wheat prices will cause less barley to be grown in all regions as producers reduce barley plantings and switch to wheat to take advantage of increased wheat prices. A $10 per tonne rise in wheat prices will cause barley production to drop by 8620 tonnes in each area. Alternatively, a 10 per cent increase in wheat prices will result in a drop of 3.0 per cent, 2.1 per cent and 2.2. per cent respectively, in barley production in Areas I, II and III.

Technology has been an important factor in increasing crop production over time. The elasticities for technology are all greater than one in all regions indicating strong responsiveness of barley production to changes in technology. As defined in the model, a one per cent increase in the technology base index value increases barley production by 2.1 per cent in Area I, and by 1.3 to 1.4 per cent in Areas II and III. The parameter estimates for wheat price and technology were provincial estimates because regional differences were not evident.

The estimates for irrigation acres were obtained using the inverse of irrigation acres in the equation. In Area I where the sign in the equation is positive, a ten per cent increase (decrease) in irrigated acreage decreased (increased) barley production by almost one per cent.

Table 4.3

ESTIMATES OF ELASTICITIES BY PRODUCTION AREA IN ALBERTA

Function and Variables	Elasticities		
	Area I	Area II	Area III
1. Slaughter Steers and Heifers			
Steer price	0.35	0.15	-0.18
Barley price	-0.10	-0.12	-0.39
Beef cow herd	0.70	0.94	1.25
Cattle slaughtered (t-1)	0.46	0.33	0.15
2. Barley Production			
Barley price	0.073	0.10	0.37
Wheat price	-0.30	-0.21	-0.22
Technology	2.06	1.40	1.31
Irrigation	-0.087	0.051	0.006
3. Beef Cow Herd			
Calf price (t-1)	0.11	0.054	0.051
Pasture acres	0.65	0.55	0.93
Canola production	-0.055	0.003	-0.045
4. Pasture Acres			
Hay price	0.56	0.37	0.43
Unimproved land	0.091	0.055	0.11
Irrigation	-0.11	0.12	0.18

This negative impact of irrigation on barley production in Area I was contrary to what was expected. To be sure, as increasing amounts of irrigation water is applied to barley acreage, yield per acre is expected to increase. But due to the relatively high cost of obtaining irrigation water, grain barley acreage is replaced by more high valued irrigated crops. The reduction in irrigated barley acreage more than

offsets the increased yield, causing an overall drop in grain barley production. Irrigation in Areas II and III is small and the estimated impacts are small, though of the expected sign. The very small elasticity for irrigation in Area III is to be expected, since the region is generally not moisture deficient and irrigation is very minor.

4.2.3 Beef Cow Herd

The supply estimates for the beef cow herd are in Table 4.2. The price of calves in the previous year (t-1) was significant in explaining the beef cow herd size in Area I and less significant in Areas II and III. This indicates that as calf prices fluctuate, cattle producers in Area I seem more inclined to expand and contract herd size than those producers in Areas II and III. In other words, cow-calf producers in Areas II and III are more committed to cow-calf production than those of Area I. Pasture acres are important in explaining the size of the beef cow herd in all regions. The expansion of canola (rapeseed) production along western edges in the foothills of Area I has resulted in a decreased cow herd in that area. Canola production in Areas II and III had little impact on the beef cow herd and the estimated parameters are not statistically different from zero.

Estimates of elasticities for the beef cow herd are in Table 4.3. A 10 per cent increase in calf prices will increase the beef cow herd 1.1 per cent in Area I, and 0.5 per cent in the other two areas. A one per cent increase in pasture acres will increase the beef cow herd by about one per cent in Area III, 0.65 per cent in Area I, and 0.55 per cent in Area II. All three of the canola production elasticities are low.

4.2.4 Improved Pasture Acres

Improved pasture acres were estimated on a provincial basis for all variables except irrigation. Hay price was used as a proxy for pasture rent. The estimates in Table 4.2 indicate that a higher hay price will stimulate an expansion in improved pasture acres.

Areas with large amounts of unimproved land also have more improved pasture acres. Irrigation reduced improved pasture acres in Area I. For each additional 100 acres of irrigation, 8 acres of improved pasture land were removed from grazing. The estimated coefficients for Areas II and III were positive, but they are not of the expected sign. It is possible that irrigation is picking up the effect of an excluded variable, though various specifications of the equation yielded similar results.

The elasticities of improved pasture acres are in Table 4.3. A 10 per cent rise in hay prices would elicit an increase in improved pasture acreage of 5.6 per cent in Area I, and about four per cent elsewhere in the province. Similarly, a 10 per cent increase in unimproved acres will expand improved pasture acreage by about one per cent in Areas I and III, and 0.5 per cent in Area II. A 10 per cent increase in irrigated acreage would result in a loss of 1.1 per cent of pasture acreage in Area I, but an increase of 1.2 and 1.8 per cent, respectively, in Areas II and III.

4.3 Factors Impacting on Slaughter Steer and Heifer Marketings

It was determined that the price of slaughter steers, the price of barley, the beef cow herd and slaughterings as representative of the previous year's slaughtering capacity, were the major factors affecting the supply of slaughter steers and heifers. Barley production was affected by the price of barley, price of wheat, technology and irrigation. The beef cow herd was affected by the calf price in the previous period, rapeseed production, and pasture acres. Furthermore, pasture acres were affected by the price of hay, unimproved land acres and irrigation. The direct and indirect effects on slaughter steer and heifer marketings can be determined with a few simplifying assumptions. The price elasticities of demand for feed barley in the production areas are assumed to be zero in the very short term. This assumption implies that the indirect impacts of wheat price, technology and irrigation are fully reflected in changes to barley prices. In the longer term, demand is more elastic and the indirect impacts on the price of barley will be lower, i.e. there is a price as well as a quantity effect.

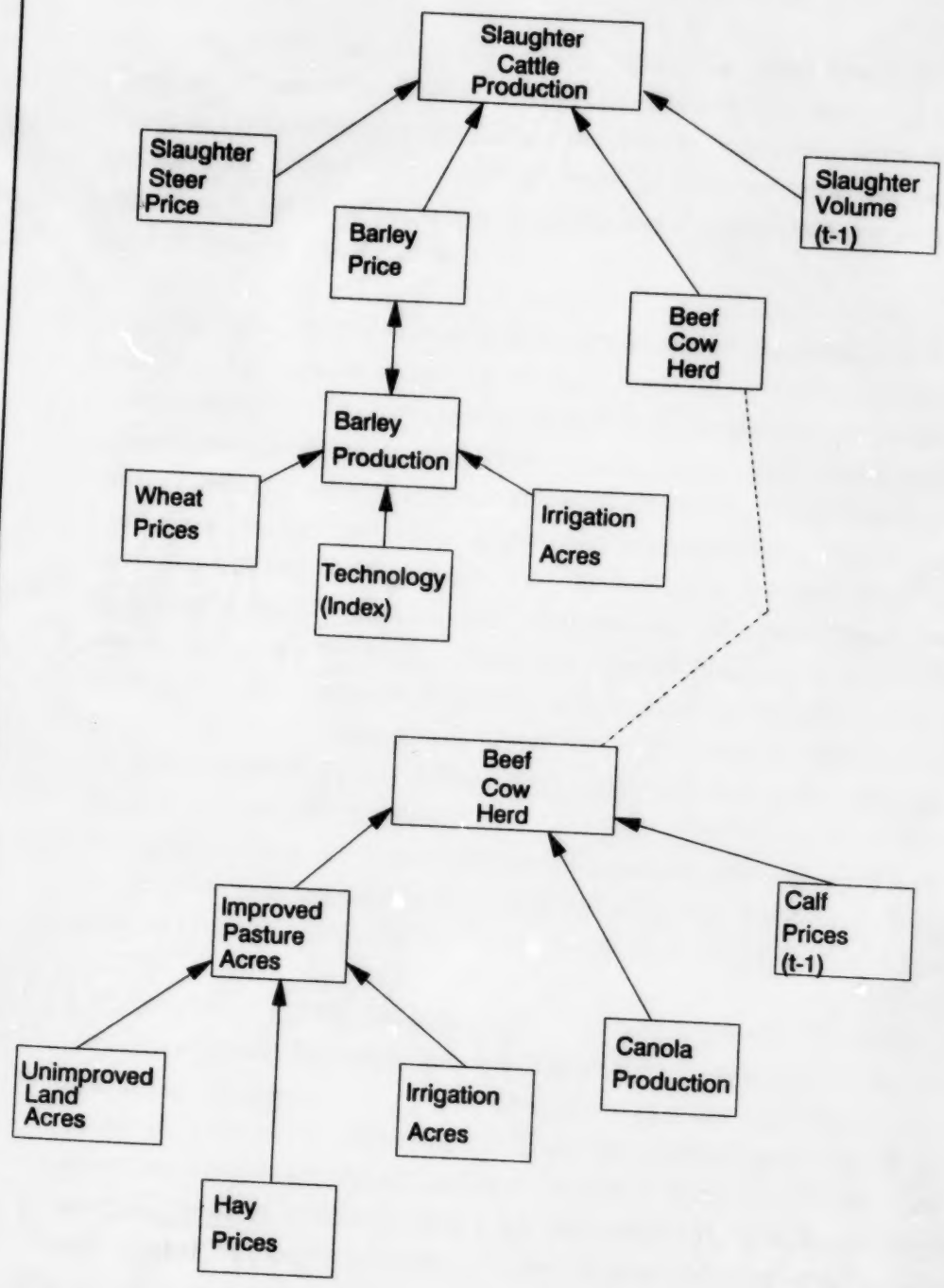
The final functional relationships are depicted in Figure 4.1. Table 4.4 summarizes the impact of all variables considered on fed or finished cattle by production area. A one per cent increase in wheat prices will reduce slaughter steer and heifer marketings by 0.18 per cent in Area III and 0.055 per cent in Area II. Of the remaining variables, technology, unimproved pasture acres and hay price have the largest effect on slaughter marketings. Calf price in the previous year, canola production, the price of hay and unimproved land have a negligible effect on the fed cattle market. A one per cent increase in irrigated acreage in Area I would reduce slaughter cattle marketings by 0.091 per cent. The elasticities for irrigation in Areas II and III indicate that increased irrigation in these regions would contribute to increased slaughter cattle marketings by 0.075 and 0.21 per cent, respectively.

Table 4.4

SHORT TERM DIRECT AND INDIRECT IMPACTS
ON SLAUGHTER STEERS AND HEIFERS

Variable	Area I	Area II	Area III
	- - - - - - - elasticities - - - - - - -		
Slaughter steer price	0.35	0.15	-0.18
Barley price	-0.10	-0.12	-0.39
Beef cow herd	0.70	0.94	1.25
Cattle slaughtered (t-1)	0.46	0.33	0.15
Wheat price	-0.14	-0.055	-0.18
Technology	0.96	0.36	1.08
Calf price (t-1)	0.077	0.051	0.064
Improved Pasture acres	0.46	0.52	1.16
Canola production	-0.039	0.003	-0.056
Hay price	0.25	0.19	0.50
Unimproved land	0.041	0.028	0.13
Irrigation	-0.091	0.075	0.21

Figure 4.1: Final Functional Relationships



V. FIELD INTERVIEWS

5.1 Rationale for Field Interviews

The objectives of the field interview exercise were twofold. Firstly, it was felt that an historical perspective would offer valuable insight for analysis. Secondly, the field interviews were intended to bridge some of the gaps in information by drawing from the vast pool of experience and opinion regarding past and present factors affecting the cattle industry in Alberta.

The beef cattle sector, relative to other agricultural production sectors, is perceived to be driven more intensively by a sense of "entrepreneurship". Individuals involved in production of weaned calves through to finishing of slaughter cattle appear more susceptible to the vagaries of the market place. Although cow-calf, backgrounding and beef finishing enterprises are dispersed province-wide, these enterprise types have tended to migrate to identifiable regions. In addition, clear examples of successful enterprises of each type are found throughout the province. In all likelihood, these "successful" enterprises have access to particular resources which enable them to prosper at their particular location. The survey questionnaire was designed to identify the human and/or physical resources attributable to these "islands of prosperity". Sixteen large cattle feeders were interviewed along with several individuals who were knowledgeable about the cattle feeding and processing business in Alberta. The Feedlot Questionnaire is included in the Appendix.

5.2 Profile of Cattle Feeders

Interviews focussed on feedlots across the province currently operating at substantial production levels, plus feed-yards considered to be of historical significance. In the latter case, these operators would be viewed as "trend-setters" in their time or of reasonable size at some point in the development of the industry. Although this was not representative with respect to the number of individuals finishing cattle across the province, it was deemed to capture the experience of

those finishing the bulk of Alberta's slaughter cattle. Rounding out the survey sample were a few individuals whose involvement with the beef industry was more related to service aspects.

Size of feedyards within the sample, based on estimated one time capacity, ranged from 3,000 head to well in excess of 40,000 head. Capacity was very sensitive to the type of cattle placed on feed over the course of the year. Feeder calves take significantly longer to finish than mid-weight feeder cattle, thereby depressing the turn rate and reducing the number of cattle that can be finished annually.

Feedyards visited exhibited a significant range of operating practices depending on the types of cattle fed. Certain lots specialized in a narrow weight range of animals and were discriminating regarding sex of stock. Others were less selective and adjusted their management and feeding practices to suit the cattle available. Still other feedyards, particularly in central and northern Alberta, are increasing by turning to backgrounding and pasture management. Emphasis was placed, especially among southern Alberta feeders, on the additional marketing options associated with larger frame cattle, eg. backgrounding; feeding dairy cattle. The larger feedlots tended to prefer shortkeep cattle, which offered the efficiencies of specialization in feeding, reduced mortality, and improved turnover rates. Some of the specialization was dependent upon ownership of cattle (owned vs. custom fed vs. external financing), and efforts to operate within a perceived production and/or market niche. Specialization or segmentation also reduced the demand for roughage in the feedlots.

Source of feeder cattle varied significantly from feedyard to feedyard. Cattle on feed were either owned, custom fed, or a combination of ownership and custom fed. Custom feeding was not restricted to feedlots, there was also custom grazing, particularly in central and northern Alberta. In areas with concentrated cattle finishing, a common observation was that local markets for feeder cattle were quite competitive. With respect to owned cattle, the focus was on

obtaining feeders at the best laid-in cost, subject to quality, size and health criteria. Feeder cattle placements originating from more than 300 km from the feedyards ranged from about 10% to close to 100% of total placements. The larger feedyards appeared more ready and able to purchase feeder cattle from greater distances than the smaller lots. Placement of local cattle (from within 100 km distance) ranged from near zero up to 75% of total. With emphasis on acquiring substantial numbers of cattle to keep large feedlots full and the greater distance from feeder sources the roles of the auction market system and order-buyers have increased over time. Proportions of cattle obtained from auction and terminal market sources ranged from 60 to 100% of total placements.

5.3 Producers Perspective

Common themes arose relating to the rationale for growth and development of cattle feeding in the province. There were also contradictory opinions.

Intensive beef production requires an ongoing awareness of feeding margins and market returns. Consequently, feedlot managers are very sensitive to related fat cattle markets. This sensitivity was observed in terminal feedyards (dedicated solely to producing slaughter cattle) and those producing both backgrounders and slaughter cattle. As the kill capacity concentrated over time in the south of the province, bids for slaughter cattle have become more competitive. Over time, the concentration of kill capacity in southern Alberta has intensified the competition for slaughter cattle among Alberta packers as well as between Alberta and U.S. packers. With this competitiveness and proximity of southern Alberta to U.S. markets, any change in relative feeding costs, exchange rates and bid prices would precipitate a shift in slaughter cattle flow to bring the market back into equilibrium.

Transportation and distance to market were highlighted as critical elements in the geographical distribution of beef cattle finishing in the province. Both access to inputs for production (including feeder cattle) and access to markets for finished product were affected by location and subsequent need for transportation services. Transport

cost and shrink differentials tend to restrict the ability of peripheral area feeders to compete in the southern-dominated domestic market as well as the alternative U.S. market. At the live-cattle-beef market interface, transportation advantages are quickly passed on through slaughter cattle bid prices f.o.b. feedlots.

Alberta cattle feeding capacity has become more U.S. export-orientated and, as a result, more sensitive to fluctuations in exchange rates. Although changes in exchange rates are assimilated relatively quickly into the domestic slaughter cattle pricing structure, the proximity of southern Alberta feedlot operators to U.S. markets allows them to take advantage of favourable short-term changes before the provincial market has had an opportunity to adjust. Domestic bids are compared daily to offers from the U.S., incorporating exchange differentials. Cattle can move either south into the U.S., eastward into Ontario markets, or be sold to local packers. Transportation costs for cattle destined for eastern markets are roughly equivalent basis northern or southern Alberta locations. However, southern Alberta producers have a transport cost advantage over their northern counterparts when moving into the northwestern United States. Given a change in exchange rates that would elicit increased southward cattle movement, feedlot operators in closer proximity to the U.S. have found that the combination of favourable pricing and lower transport costs offered a better margin on southbound sales than the local or eastern alternatives. At the same time, producers more distant from the U.S. would continue to find eastern and local bids more appealing because they have not yet reached the threshold where U.S. shipments are more profitable arising from higher transport costs. This perceived advantage to southern Alberta producers would be more pronounced at times when export sales are large and Alberta plants are operating near capacity.

Study participants focussed on such elements as ethnic influence, entrepreneurial attitudes and abilities, intergenerational transfer of farms, influence of sugar beet production, economies of size, custom feeding, grain markets, cooperative ventures, influence of irrigation

climate, government and other concerns. Each of these elements had an impact on industry establishment and development.

The effect of ethnicity appears, in part, to be connected with entrepreneurial attitudes and also perhaps with a cultural influence on production practices. In earlier times, many U.S. immigrants with cattle experience and more recently, northern European immigrants with intensive cattle management experience settled in southern Alberta. Their interest in this particular business enterprise was related to risk taking entrepreneurial ability, familiarity with intensive livestock production practices, and recognition of intensive cattle feeding as a sound business opportunity for farm diversification, value added and profit. On the other end of the spectrum, other settlers characterized by more conservative business approaches were purported to avoid the cattle finishing business due to its inherent risk and cash flow requirements. Instead, these farmers concentrated on the more extensive cow-calf business and grain production. Such attitudes may be difficult to attribute to persons of particular ethnic origins, but commonalities among successful operations and production specialization were certainly highlighted.

A common note by all individuals interviewed was that in order to succeed in the cattle feeding business, certain entrepreneurial qualities were essential. The business of finishing beef cattle is typified by low margins and substantial risk. Success in an enterprise with such characteristics requires an aggressive approach in terms of both margin and risk management. The questions pertaining to ideal feedlot location had a common response, especially among the larger cattle feeders. Although their current location was likely the one at which they would wish to remain, they noted quite firmly they would be in the business of feeding/finishing cattle regardless of the location. This suggested a degree of confidence in their entrepreneurial abilities as cattle feeders.

Intergenerational transfer of farming operations offered some insight into the rationale for location and specialization in beef

feeding. A number of feedyards visited had been in the family for a significant period of time, either passed down to the current owner or in the process of transition to the next generation. The obvious linkages to cattle feeding were twofold. Firstly, cattle feeding experience appeared to be passed on from one generation to the next. Secondly, given an opportunity to assume control of a going concern over time without being encumbered by excessive debt may have put operations in an advantageous position to continue in slaughter cattle production.

The role of the sugar beet industry in the development of the southern Alberta cattle feeding industry was often highlighted. In the earlier days of sugar beet processing wet beet pulp was a major waste by-product. This wet pulp was a low cost, ideal cattle feed. Consequently, small cattle finishing lots sprung up around sugar beet plants. With beet pulp (and beet tops), feeding margins were substantial relative to other feeding alternatives. Quotas for distribution of wet beet pulp were established relative to beet acreage and historical levels of pulp purchase. The feeding industry was well suited to small feedyards located next door to sugar beet plants. Over time, the plants shifted to processes producing a dry pulp by-product as opposed to the wet beet pulp. Defoliators eliminated the need to harvest beet tops. The dry pulp was not as acceptable as a cattle feed and the satellite feedyards began to disappear. Those feedyards remaining were larger, more efficient operations able to continue in business under the tighter margins. It is important to note the beet pulp industry was not so much driven by the potential for cattle feeding as the cattle feeding industry appeared to be an offshoot of beet production and processing. As sugar beet production became commercially viable through irrigation, it follows that cattle feeding benefited indirectly from irrigation.

Economies of size were frequently indicated as a competitive edge in improving the overall operating margins. Scale economies are achieved by reducing per unit overhead cost, and gaining buying and selling efficiencies only available at larger volumes of business. For example, investment often extended beyond the capital and labour

directly involved in cattle finishing to participation in complementary enterprises such as livestock trucking and ownership of feedmilling facilities. A number of feedlot operators linked size of lot expansion to necessary feedmill capacity and labour requirements, which at current standards is equivalent to two to five thousand head standing capacity.

Earlier cattle feeding activity tended to involve direct ownership of cattle but in the past twenty years, custom finishing of cattle began to gain prominence. The impetus for custom feeding of cattle was due to a number of factors. Custom feeding gave cow-calf operators the opportunity to take advantage of superior feeding efficiencies available in specialized feedyards while retaining ownership of their livestock. Custom feedyards were patronized by individuals from within and outside the agricultural sector as a conduit for business activity. Cattle feeding was viewed by people outside the industry as a business investment or in some cases as a means of reducing their tax exposure. As well, individuals with expertise in marketing used custom lots as an intermediary in their business practices. The ability of custom lots to pass on to customers any efficiencies due to scale economies was dependent upon their pricing structure and marketing ability. With the advent of custom feedyards, the volume of cattle finished in the province has increased beyond what would be possible under conventional ownership. The feedlot owner carries the overhead risks, but shares the risks related to feeder acquisition, in-lot feeding and final marketing with the investor.

There was a unanimous view that low grain prices during the 60's was a major impetus for growth of feedlot activity at that time. Marketing grain through beef became a viable economic alternative. This took the form of selling feed grains to cattle feeding operations or diversification of farming activities to include on-site feeding facilities. These prolonged periods of depressed grain prices also provided an incentive for some of the cooperative ventures formed throughout the province.

Cooperative cattle feeding ventures cover a broad range of business arrangements with the common theme of gaining operating efficiencies by centralizing feeding. There are a number of examples of businesses established as a means of marketing surplus feed grains and/or finishing feeder cattle owned by the members. Groups of producers banded together to form cattle feeding companies through which they could market their grains. Similarly, larger cow-calf producers have been known to enter joint cattle feeding ventures, supplying their own to take advantage of scale and marketing economies. In many instances, these cooperative ventures have progressed past the intent of the original producers to become corporate cattle feeding entities in their own right.

Cooperatives of cattle feeders, such as the now-defunct "Lethbridge Cattle Feeders Association" were also established as a route to obtain interim financing for cattle feeding. Membership dues were used as additional security on cattle purchases to obtain financing at reasonable rates. The cooperative or joint venture approach to cattle feeding was a significant contributor to Alberta's current cattle feeding capacity.

The role of irrigation in the regional distribution of cattle feeding in Alberta is subject to a number of conflicting views, especially related to aspects of unit cost. Interviews indicated that the link of cattle feeding to wet beet pulp has been replaced by a link to feed grain and forage production, especially silage. Given that barley production is a dominant enterprise in its own right and silage production is viewed as an integral component of rotations on irrigated lands, this linkage appeared to be tenuous. On one extreme, a group of producers felt that past and current government spending on irrigation has filtered into the cost structure of crop production and has created a situation whereby feeds are available at lower cost and greater quantities. At the other end of the spectrum, operators were of the opinion that the only direct linkage between irrigation and cattle feeding was through provision of stock water supplies to a limited number of individuals. Stock water sources were observed as frequently arising from irrigation sources but much of the usage noted was met by

infrastructure laid in earlier in the century. Impressions obtained through the southern Alberta field interviews closely linked irrigation with crop production and downplayed the connection with the later development and ongoing expansion of the feedlot industry in that region. Most cattle feeders in the south acknowledged that the importance of irrigation rested more in the assured supply of silage and stock water.

5.4 Other Comments

The individuals interviewed generally have a comprehensive understanding of the economics of cattle feeding at the local provincial as well as the national and continental levels. There were a number of common opinions related to the influence of climate sensitivity to environmental, health and animal welfare issues, future trends, government intervention, and U.S. - Canada trade.

Climate or environment was referred to by all respondents as a critical element in the provincial distribution of cattle feeding. The primary focus of the comments was on physical feeding efficiencies and impact of weather on associated production costs.

There was general agreement that a warmer drier climate was more conducive to feeding efficiencies and rates of gain. However, there was some divergence of opinion on the relative impacts of temperature variability in the south versus lower but stable temperatures in the north. Nonetheless, southern cattlemen believed that the higher mean temperature enjoyed in the south more than compensated for the daily temperature variability.

The need for greater usage of bedding in colder, wetter areas was well recognized by all study participants. This requirement was detrimental to feeding margins not only in terms of the bedding costs but also increased costs associated with manure removal.

The interface with non-agricultural components of society was recognized. Environmental concerns related to potential water, odor and

noise pollution were viewed as functional guidelines for their operation. In the progression from older to newer feedyards, efforts to accommodate environmental regulations were not only apparent but in some cases seen as a basis for developing an environment more amenable to cattle feeding. Older feedyards were in some cases observed to be operating under a scenario of sunk investment within the constraints of more recent regulatory provisions. In addition to environmental issues, feedlot operators appeared to be aware of the public health aspects of primary food production as perceived by the consuming public. On a final note, the issue of animal welfare was recognized as significant by many of those interviewed and given due emphasis in their operations.

Opinions varied with respect to expectations of trends in business practices in the future and historical factors affecting the distribution of cattle feeding in Alberta. It would appear that expectations for the future are generally formed relative to their individual operations.

Expectations of future business activity focussed upon aspects of custom feeding and the type of cattle placed in feedyards. Some individuals thought that custom feeding will play a more dominant role in the future whereas others felt the bulk of cattle fed will be under private ownership. Definite preferences were stated by all operators regarding the role of custom cattle in their own businesses. Certain operations expected to see an increase in the percentage of long keep cattle placed in lots as opposed to others who felt that long cattle will all but disappear due to declining markets. Instead, backgrounding will gain greater popularity as feeders try to gain access to the manufacturing beef market.

Most producers expressed concerns about Alberta's competitiveness in beef production and the future of the industry. Producers interviewed expressed concerns with the implications of government policies and programs on the beef industry. The common theme related to distortions in market signals and impediments to further growth and development. Statutory rates (i.e. the "Crow" issue) were universally

viewed as an impediment to the achievement of full livestock industry potential in Alberta. At the meat packing level, government involvement with selected plants was considered to be inhibiting industry rationalization that must take place in order to attain competitiveness in the North American market. An industry-wide concern related to the resolution of Canada-U.S. grading and border inspection issues which were creating significant pricing anomalies and blocking marketing opportunities. In general, producers voiced their concerns that government must recognize the full implications of its involvement in the agriculture sector, especially with regard to actions that impede development according to natural competitive advantage.

On a final note, cattle feeding in Alberta has been typified by intensive feedlot facilities supplied with feeder cattle from a more extensive, yet capital-oriented, cow-calf industry. There is some divergence of opinion regarding the future location of cattle feeding activity in the province. However, consensus is developing regarding the forage-based focus of the backgrounding industry. Producers are already turning to intensive pasture management for backgrounding cattle. In fact, a small group of producers feel that with less government involvement and changes in the Crow benefit method of payment, many croplands would eventually revert to forage and grazing. Planned grazing, with its relatively low overhead, allows feeders to market forage through cattle. There is a small but growing perception that central and northern Alberta will produce and background cattle for southern feedlots.

VI. SUMMARY AND CONCLUSIONS

6.1 Summary

Alberta is well endowed with natural resources which support a thriving beef cattle industry. There is an abundance of native and improved pasture, forages and feed grains. Water is also in abundant supply. These above resources provide the necessary conditions for a thriving beef cattle industry.

The grain glut of the 60's and early 70's and the accompanying low grain prices were major stimulants to the growth in the cattle feeding industry in Alberta. Since the late 60's cattle feeding has become increasingly concentrated in the southern half of the province. Of the total slaughter steers marketed in 1988, 41.2 per cent occurred in the southern CDs 1, 2, 3 and 5 (Area I), 42.4 per cent in central CDs 4, 6/9, 7 and 8 (Area II), and only 16.4 per cent in northern CDs 10 to 15 (Area III).

Cattle slaughtering has also become more concentrated in southern Alberta. Between 1969 and 1988, slaughterings at federally inspected plants have risen from 32 per cent to 41.8 per cent in Area I, and from 31 per cent to 46.1 per cent in Area II. In contrast, slaughterings dropped from 37 per cent to 12.1 per cent in Area III. The concentration in the south is most noticeable in Census Division 2 (Lethbridge, Taber, Warner area), which reported slaughterings of 41.7 per cent, up 15.5 per cent from 1969.

At the same time the cow-calf industry has become more concentrated in northern Alberta. But given the abundance of natural resources in northern Alberta, the cattle feeding business has not developed as expected in this part of the province relative to southern Alberta. This lack of development has occurred despite an apparent feed cost advantage in northern Alberta. In 1989 it cost $3.11 to produce a bushel of barley under irrigation, compared with $2.25 per bushel in the Vermilion area. The costs for silage were $31 and $21 per tonne, respectively.

This underdevelopment in cattle feeding raises several questions about the cause and effect of the location of cattle feeding/ slaughtering the province. Why has southern Alberta experienced such rapid growth in cattle feeding and slaughtering since the 60's? What role has the government played in influencing the distribution of production in Alberta? Has irrigation impacted the development of livestock in southern Alberta? Questions such as these are broader than those posed in the 1988 Alberta Cattle Commission resolutions. This study was undertaken specifically to address these questions.

Several factors were identified and tested in the statistical model to examine their impacts on the cattle feeding industry. In addition, interviews were conducted with a number of major cattle feeders and individuals knowledgeable about the beef cattle industry in the province. Current production and transportation cost issues were also investigated. This information was helpful in supplementing and complementing the quantitative analysis.

An economic model was developed to test the various inter-relationships in the cattle industry, more specifically, variables influencing the location of the beef cow-calf herd, cattle feeding and slaughtering in the province. Variables were accepted or rejected based on data availability, and statistical consistency and significance. A graphical representation of the model is given in Figure 6.5.

The variables which were statistically significant for the feeding sector were:

- price of slaughter cattle
- price of barley
- beef cow herd
- slaughterings in previous years

Variables which were statistically significant in barley production were:

- barley price
- wheat price
- technology
- irrigation

Variables which were statistically significant for the beef cow herd were:

- price of calves
- pasture acreage
- canola production

The variables which were statistically significant for the improved pasture acres were:

- price of hay
- unimproved acreage
- irrigation acreage

The combined influence of all of these variables on marketings of slaughter steers and heifers revealed significant regional differences in cattle feeding. Higher slaughter cattle prices led to increased feeding in Areas I and II, but reduced feeding activity in Area III. Southern Alberta producers were able to outbid their northern Alberta counterparts for calves during relatively high slaughter cattle prices.

Cattle feeders in southern Alberta were far less sensitive to barley price changes than producers in the north. This may be a result of various production alternatives in the north and a greater reliance on cattle feeding in the south, and/or tighter margins in the north and therefore a relatively greater response to input price changes.

The size of the beef cow herd also positively affected the level of feeding activity throughout the province. The impact, however, was

greater in northern Alberta than in the south where cattle feeders have become less dependent on a local beef cow herd.

Undoubtedly, processing plants followed the cattle. But once in place, the expanded industry infrastructure had a significant effect on the relocation of cattle feeding to the area. Processing capacity as represented by the previous year's cattle slaughtering, showed a greater positive impact on cattle feeding in southern Alberta than elsewhere in the province. An increase in cattle slaughtering activity had three times greater impact on fed cattle marketed in the south compared to the north. The presence of beef processing plants did not guarantee that cattle would be finished in an area, especially in Area III.

The price of wheat and canola production had a minor negative effect on cattle marketed for slaughter. Grain production technology had a major impact on fed cattle marketed. The impact through increased barley production and reduced feed costs was about one and one-half times as great in Area I relative to other parts of the province. As expected, pasture acres had a positive effect on the beef cow herd size and fed cattle marketed. The pasture impact on marketings was highest in northern Alberta. Similarly, the price of calves had a positive effect on the beef cow herd and hence on fed cattle marketed.

The hay price and unimproved land all had a positive effect on pasture acreage but the impacts were not large. Irrigation had a negative effect on grain barley production and pasture acres, and hence cattle feeding in production Area I, which contains most of the irrigated acres in Alberta. Elsewhere in the province, irrigation had a positive effect on cattle feeding. Considering the amount of irrigation in these regions, the total effect on cattle marketed for slaughter was minimal.

6.2 Conclusions

A number of factors and events have influenced the regional growth and development of the cow-calf and cattle feeding industries in

Alberta. The beef cow herd is most sensitive to calf prices and pasture acreage, while the number of cattle slaughtered is most sensitive to slaughter cattle prices, barley prices, size of the beef cow herd and processing capacity.

Southern producers are relatively more sensitive to prices of their output, that is, calf prices and slaughter cattle prices, than those producers elsewhere in the province. However, they are relatively less sensitive to barley prices than northern producers. The grain glut of the late 60's and early 70's provided an opportunity for *all* Alberta cattlemen to expand their feeding operations. That cattle feeding greatly expanded in the south, reflected greater risk taking, fewer production options, and probably wider feeding margins than in northern Alberta.

There is no doubt that irrigation has played a very significant role in the development of agriculture in southern Alberta. The introduction of irrigation and sugar beet production made wet beet pulp and beet tops available for cattle feeding. Several feedlots developed around the sugar beet plants in southern Alberta to take advantage of these by-products.

As it did with beet pulp and beet tops, intensive cattle feeding provided a market for barley silage. Most feedlots in southern Alberta emphasized the importance of security of supply of irrigated silage for feeding. The database for silage was insufficient to be directly included in the model as a variable. However, to the extent that barley silage is priced relative to barley grain, the influence of silage is captured in the slaughter cattle model results.

The availability of drinking water for stock is critical in determining the establishment and expansion of cattle feeding. Irrigation has increased the availability as well as security of stock water within the irrigation districts of southern Alberta. Northern Alberta has abundant water and the cow herd to sustain a viable cattle feeding industry. Yet, such an industry has not emerged. Therefore it

could be concluded that water is not the only explanation for the expanding cattle feeding business in the south.

Access to U.S. markets cannot be overlooked. Feedlots in southern Alberta are closer to U.S. markets. As such, they may be in a position to take immediate advantage of small changes in exchange rates not available to their more distant counterparts. Estimates of transportation costs indicate that any savings gained in shipping meat to, say the Los Angeles market, is more than offset by the cost of importing both grain and feeder cattle from northern Alberta into southern Alberta. Nevertheless, cattlemen in the south have established their sources of feeder calves by consistently out-bidding their northern counterparts. Moreover, given the scale and intensity of the feeding activity in southern Alberta, processors and order-buyers are more readily attracted to that area than elsewhere in the province.

Producers in the southern region more readily expand feeding activity in response to higher slaughter prices than producers in northern Alberta. In the northern region, finishing actually declines with higher slaughter prices. This seemingly contradictory reaction in the north may be explained by the close linkage between feeding operations and the cow-calf enterprise. As slaughter cattle prices increase so do calf prices and many farm feedlots may choose to sell calves as opposed to assuming the risk of backgrounding or feeding them for the slaughter market. Northern Alberta has a high concentration of cow-calf operations which background and finish their own cattle.

The model results indicate that irrigation expansion does not appear to have increased the availability of barley for feeding, or to have lowered prices for feedgrain in southern Alberta relative to other regions. On the contrary, ongoing research results from cost of production studies undertaken by the Production Economics Branch confirm that net returns to grain and silage production under irrigation are substantially lower than under dryland in central and northern Alberta. Benefits from public expenditures on irrigation are quickly capitalized in land values. Consequently, as irrigated acreage expands, barley

production is replaced by higher valued crops. Reduced barley acreage increases the acquisition costs of barley, which in turn has a negative effect on cattle feeding. Indeed, there is a reduction in cattle feeding activity in all regions when barley prices rise.

Irrigation in the southern region has been shown to reduce cow herd size, as dryland pasture is converted to irrigated crops, including specialized cash crops. Model results also indicate that expanded irrigation comes at the expense of pasture acreage. This reduction in pasture acreage is accompanied by a reduction in the cow herd in the south, which in turn has a negative effect on cattle feeding.

There was no evidence to suggest that a decline in cattle feeding in southern Alberta would result in increased feeding activity in northern Alberta. On the contrary, a contraction in the feeding industry in the south could precipitate a drop in the inflow of feeders to Alberta from other western provinces, and greatly intensify the outflow of feeders to the United States and eastern Canada. Therefore, while irrigation has removed two critical constraints to an expanding cattle feeding business in southern Alberta, it is not clear that irrigation has been a detriment to cattle feeding in northern Alberta.

There is a growing consensus that the southern Alberta climate, being generally warmer and drier, is more conducive to finishing cattle. Given that feed as well as feeder costs are higher in the south, a climatic and feeding efficiency advantage to some degree must be offsetting the relatively higher costs of inputs in the south.

Further research is required in a number of areas. Specifically, there is a need to better document the extent of silage production, and to evaluate the role of forage in livestock production and backgrounding in Alberta. Secondly, there is a need to examine the effect of climate on production, particularly on feeding efficiencies, and to establish if there are feeding efficiency differences across the province. Further research is also needed on the contribution of the human element or management in the overall cattle feeding equation.

Finally, since the late 1960's the structure of the North American beef industry has undergone rapid and substantial changes. The changes have reverberated throughout the entire beef industry. Alberta cattlemen and processors are very concerned about the future of this vital industry in Alberta. The time is opportune for an indepth look at the future profitability and competitiveness of Alberta's beef industry.